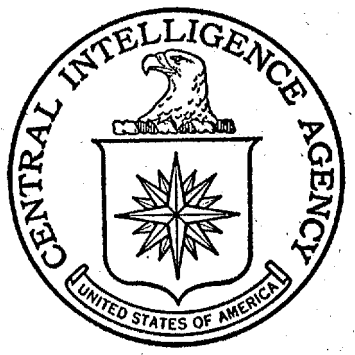
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

~~SECRET~~
US OFFICIALS ONLY

15

RESEARCH AID

CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR, 1945-55



CIA/RR RA
27 September 1954
ORR Project 25.186

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

US OFFICIALS ONLY
~~SECRET~~

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

WARNING

This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, USC, Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

~~SECRET~~

US OFFICIALS ONLY

RESEARCH AID

CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR, 1945-55

CIA/RR RA

(ORR Project 25.186)

CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

US OFFICIALS ONLY

~~SECRET~~

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

CONTENTS

		Page
Summary		1
I.	Introduction	4
II.	Motor Transport	5
III.	Rail Transport	7
IV.	Civil Air Transport	7
V.	Water Transport	8
VI.	Agriculture	10
VII.	Households	13
VIII.	Industry	14
IX.	Conclusions	16

Appendixes

Appendix A.	Estimated Annual Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector	19
Appendix B.	Methodology	31
Appendix C.	Gaps in Intelligence	81
Appendix D.	Sources	83

Tables

1.	Estimated Civil Consumption of Petroleum Products in the USSR, by Consuming Sector, 1945-55	2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

		Page
2.	Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product, 1945-55	3
3.	Estimated Consumption of Petroleum Products by Motor Transport in the USSR, by Type of Product, 1945-55	6
4.	Estimated Consumption of Petroleum Products by Rail Transport in the USSR, by Type of Product, 1945-55	8
5.	Estimated Consumption of Petroleum Products by Civil Air Transport in the USSR, by Type of Product, 1945-55	9
6.	Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product, 1945-55	10
7.	Estimated Consumption of Petroleum Products by Agriculture in the USSR, by Type of Product, 1945-55	11
8.	Estimated Consumption of Kerosine in Households in the USSR, 1945-55	14
9.	Estimated Consumption of Petroleum Products by Industry in the USSR, by Type of Product, 1945-55	15
10.	Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1945 . .	20
11.	Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1946 . .	21
12.	Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1947 . .	22
13.	Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1948 . .	23
14.	Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1949 . .	24
15.	Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1950 . .	25

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Page

16. Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1951 . . 26

17. Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1952 . . 27

18. Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1953 . . 28

19. Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1954 . . 29

20. Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product and by Consuming Sector, 1955 . . 30

21. Estimated Consumption of Petroleum Products by Motor Transport in the USSR, 1945-55 32

22. Estimated Consumption of Petroleum Products by Rail Transport in the USSR, 1945-55 34

23. Estimated Consumption of Petroleum Products by Civil Air Transport in the USSR, 1945-55 35

24. Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product and by Type of Fleet, 1946 and 1951 37

25. Estimated Consumption of Diesel Fuel by the Soviet Inland Fleet, 1951-55 44

26. Estimated Consumption of Diesel Fuel by the Soviet Ocean Fleet, 1951-55 45

27. Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Fleet and by Type of Product, 1951-55 46

28. Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Fleet and by Type of Product, 1945-55 49

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Page

29. Estimated Consumption of Petroleum Products by Agricultural Tractors in the USSR, 1945-55 51

30. Estimated Consumption of Petroleum Products by Agricultural Combines in the USSR, 1945-55 56

31. Estimated Consumption of Petroleum Products by Agricultural Machines in the USSR, by Type of Product, 1945-55 60

32. Estimated Number of Kerosine Lamps in Households in the USSR, 1945-55 61

33. Estimated Consumption of Lamp Kerosine in Households in the USSR, 1945-55 62

34. Estimated Consumption of Stove Kerosine in Households in the USSR, 1945-55 63

35. Estimated Consumption of Petroleum Products by Industry in the USSR, by Type of Product, 1951 69

Charts — Following Page

1. USSR: Estimated Civic Consumption of Petroleum Products, by Consuming Sector, 1945-55 18

2. USSR: Estimated Civil Consumption of Petroleum Products, by Type of Product, 1945-55 18

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

CIA/RR RA
(ORR Project 25.186)

S-E-C-R-E-T

CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR, 1945-55*

Summary

Analysis of the seven petroleum-consuming sectors that make up the Soviet civil economy** indicates that consumption of petroleum products has increased rapidly in the years from 1945 through 1953. The average annual rate of growth is estimated to have been about 16 percent. Correlating this trend with the petroleum production goal of the Fifth Five Year Plan suggests that the average annual increase during 1954 and 1955 will be less, about 13 percent. These rates of increase are several times higher than those for the US. From 1945 through 1953 in the US, domestic demand increased only 5.8 percent, and the rates forecast for 1954 and 1955 range from 3 percent to 3.5 percent.

Estimated civil consumption of petroleum products in the USSR, by consuming sector, 1945-55, is given in Table 1.*** Consumption in each sector is shown to rise throughout the period. The industrial sector has been the largest consumer, followed by agriculture -- except in 1945, when their positions were reversed. Over the period, consumption of petroleum by the motor transport sector has shown the fastest rate of growth. By 1955 it is estimated that these three sectors -- the industrial, agricultural, and motor transport -- will account for nearly 80 percent of the total civil consumption of petroleum in the USSR.

Estimated consumption of petroleum products in the USSR, by type of product, 1945-55, is presented in Table 2.**** With the exception of ligroin,***** consumption of each type of product is

* The estimates and conclusions contained in this research aid represent the best judgment of the responsible analyst as of 24 August 1954.

** Consumption estimates in this research aid include only the Soviet civil economy; no estimates are made for petroleum consumption of the Soviet military forces.

*** Table 1 follows on p. 2.

**** Table 2 follows on p. 3.

***** Ligroin is a light petroleum distillate used primarily as a tractor fuel.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 1

Estimated Civil Consumption of Petroleum Products in the USSR, by Consuming Sector a/
1945-55

Thousand Metric Tons

Consuming Sector	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Motor Transport	1,097	1,596	2,694	3,318	4,241	5,015	6,137	7,060	7,734	8,482	9,132
Rail Transport	648	687	702	858	1,014	1,129	1,261	1,369	1,460	1,534	1,589
Air Transport	156	179	198	219	240	273	311	349	387	426	458
Water Transport	1,842	1,958	2,082	2,199	2,323	2,440	2,564	2,849	3,212	3,500	3,725
Agriculture	3,275	3,895	4,985	6,132	6,943	7,680	8,643	9,369	10,772	11,973	14,009
Household	1,840	1,886	1,932	2,026	2,171	2,317	2,698	3,163	3,732	4,661	5,715
Industry	3,252	4,036	5,025	6,153	7,500	9,314	11,077	13,787	15,026	17,404	19,710
Total	12,110	14,237	17,618	20,905	24,432	28,168	32,691	37,946	42,323	47,980	54,338

a. Data in this table have been compiled from Tables 3 through 9, below.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 2

Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product a/
1945-55

Thousand Metric Tons

Product	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Gasoline	1,378	1,908	3,112	3,819	4,834	5,721	7,031	8,108	8,928	9,780	10,612
Ligroin			615	617	523	517	548	649	732	323	0
Kerosine	5,342 b/	6,028 b/	6,003	7,050	7,543	8,082	8,976	9,072	9,669	10,418	11,351
Diesel Fuel			470	724	1,281	2,111	3,111	5,066	6,589	8,800	11,625
Residuals	4,528	5,306	6,210	7,299	8,617	9,878	10,935	12,717	13,834	15,687	17,419
Lubricants	862	995	1,208	1,396	1,634	1,859	2,090	2,334	2,571	2,972	3,331
Total	12,110	14,237	17,618	20,905	24,432	28,168	32,691	37,946	42,323	47,980	54,338

a. Data in this table have been compiled from Tables 3 through 9, below.
b. Aggregate figure for ligroin, kerosine, and diesel fuel.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

shown to increase throughout the period. The rate of growth of consumption of gasoline is indicated to have been greater than that of the other products, which correlates with the growth of consumption by motor transport shown in Table 1. Of particular interest is the rate of growth of consumption of diesel fuel since 1950. This increased rate stems primarily from a shift in the types of tractors used in agriculture; diesel tractors have been added to the agricultural tractor park in greater numbers each year. Contributing to this rate increase are growing numbers of diesel units in industry and in both rail and water transport. Ligroin is expected to disappear from the list of petroleum products consumed by the civil economy in 1955.

The recently emphasized consumer goods and agricultural program in the USSR is expected to have a significant effect on the consumption of petroleum by only two petroleum-consuming sectors of the civil economy, the household and agricultural sectors. The new program, which provided for increased production of kerosine stoves, was followed by a sharp decrease in the retail price of kerosine, and consumption of kerosine by Soviet households will probably increase substantially. Tractor deliveries to the agricultural sector were stepped up in 1953, and -- presuming the program will continue through 1954 -- petroleum consumption by agriculture is expected to increase sharply in 1955.

I. Introduction.

This research aid is concerned exclusively with consumption of petroleum products by the civil economy of the USSR. Because peacetime military consumption is not included, the totals do not present the over-all petroleum consumption for the USSR. They will, however, facilitate analysis of the petroleum supply-demand balance of the USSR, which, in turn, will lead to more reliable estimates of the petroleum factor of the Soviet capabilities for war.

The civil economy of the USSR is analyzed in terms of seven petroleum-consuming sectors. All relevant aspects of each sector are analyzed, and estimates of petroleum consumption, by type of

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

product, have been made for each sector for the years from 1945 through 1953. On the basis of the trends established for these years, together with pertinent goals of the Fifth Five Year Plan, forecasts of consumption of petroleum have been made for 1954 and 1955. For each sector, therefore, a consumption series for 11 consecutive years is given.

In view of the statistical nature of this research aid, the methodology used to establish the estimates is of prime importance. Because the methodology differs from one consuming sector to another, details are assembled in appropriate subsections of Appendix B. Only general methodology is indicated in the text.

II. Motor Transport.

Estimates of consumption of gasoline and lubricants by motor transport in the USSR can be made in a number of different ways. Perhaps the most frequently used method is that of first estimating the size and composition of the vehicle park and then applying mileage and consumption rates. Such a method yields adequate results only when each individual factor in the computation is known within a small range of error, usually less than plus or minus 5 percent. Available information does not warrant the use of this method in the present problem.

Estimated consumption of petroleum products by motor transport in the USSR, by type of product, is shown in Table 3.* In deriving the estimates, use has been made of data on performance of the Soviet truck fleet. These data, which take the form of billions of ton-kilometers of freight, are derived in large part from Soviet sources and are believed accurate within a small range of error. Heretofore the difficulty in using these data to estimate gasoline consumption has been the lack of a reliable consumption factor per ton-kilometer of freight. Such a factor has been derived in Appendix B, Section 1, and is believed accurate within a range of error of plus or minus 10 percent. The margin of error for gasoline consumption by freight-carrying vehicles in the USSR is, therefore, believed to be not more than plus or minus 10 percent.

Unfortunately, there are no data available on total passenger-kilometers that could be used to arrive at estimates of consumption

* Table 3 follows on p. 6.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 3

Estimated Consumption of Petroleum Products
by Motor Transport in the USSR, by Type of Product a/
1945-55

Thousand Metric Tons

Year	Gasoline b/	Lubricants	Total
1945	1,045	52	1,097
1946	1,520	76	1,596
1947	2,566	128	2,694
1948	3,160	158	3,318
1949	4,039	202	4,241
1950	4,776	239	5,015
1951	5,845	292	6,137
1952	6,724	336	7,060
1953	7,366	368	7,734
1954	8,078	404	8,482
1955	8,697	435	9,132

a. Data in this table have been compiled from Tables 10 through 20, Appendix A.
b. Diesel units comprise less than 1 percent of the total civil motor vehicle park, and consumption of diesel fuel is considered negligible.

by passenger vehicles. To include this quantity, consumption of gasoline by trucks has been increased by 10 percent, which may be in error by as much as plus or minus 50 percent.

Estimates of consumption are of lubricants based on consumption of gasoline. Undoubtedly, rates of consumption of lubricants vary widely from one motor vehicle to another, generally depending more on the age and condition of the engine than on the vehicle model. On the average, however, a lubricant consumption factor equal to 5 percent of the fuel consumed is considered reasonable and is confirmed by a number of Soviet sources. The range of error inherent in this estimate is not believed to exceed plus or minus 20 percent. The cumulative effect of the errors in estimates of gasoline and

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

lubricant consumption by all forms of motor transport is believed to be less than plus or minus 12 percent.

III. Rail Transport.

Estimated consumption of petroleum products by rail transport in the USSR, by type of product, for 1945-55 are shown in Table 4.* As have the motor transport estimates, the data have been derived from estimates of performance of rail transport. The relationship of petroleum fuels to total fuels expended in accomplishing the ton-kilometer performance has been determined for 1951, and the same relationship is believed reasonably valid for the 1945-55 period. A significant change in the types of locomotives used would invalidate this relationship, but no such change has been verified. Application of this relationship to a 1945-55 ton-kilometer series yields a total petroleum fuel consumption for that period. These totals have been apportioned between diesel fuel and residual fuel oil by estimating consumption of diesel fuel separately and subtracting it from total consumption of petroleum fuel. The remainder is, therefore, a figure for residual fuel oil.

To obtain estimates of lubricant consumption, lubricant consumption factors based on US experience have been applied to the performance data. (See Appendix B, Section 2, for methodological details.)

Because the relationship of petroleum fuel to total railroad fuel determined for 1951 is based on 1946 Soviet data, and because this relationship has been applied to all years in the 1945-55 period, the estimates of total petroleum fuel consumption by rail transport in the latter part of the period may be in error by as much as plus or minus 25 percent. Data used to apportion these totals between diesel fuel and residual fuel oil are largely unconfirmed and may be in error by plus or minus 50 percent. Although estimates of lubricant consumption are based on US experience, it is believed that their margin of error does not exceed plus or minus 25 percent.

IV. Civil Air Transport.

Estimated consumption of petroleum products by civil air transport in the USSR, by type of product, 1945-55, is shown in

* Table 4 follows on p. 8.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 4

Estimated Consumption of Petroleum Products by Rail Transport in the USSR, by Type of Product a/ 1945-55

Thousand Metric Tons

Year	Diesel Fuel	Residual Fuel Oil	Lubricants	Total
1945	33	564	51	648
1946	39	594	54	687
1947	53	594	55	702
1948	79	712	67	858
1949	128	806	80	1,014
1950	191	849	89	1,129
1951	264	897	100	1,261
1952	344	916	109	1,369
1953	432	911	117	1,460
1954	521	890	123	1,534
1955	625	836	128	1,589

a. Data in this table have been compiled from Tables 10 through 20, Appendix A.

Table 5.* Included in these totals are estimates of consumption by scheduled commercial air transport, nonscheduled air transport, and miscellaneous civil air operations. Consumption of lubricants, estimated on the basis of US experience, is derived as a percentage of the fuel consumption. The estimated margin of error is considered to be not more than plus or minus 10 percent. (Details of the computation are given in Appendix B, Section 3.)

V. Water Transport.

Estimated consumption of petroleum products by water transport in the USSR, by type of product, 1945-55, is shown in Table 6.** Figures are based on separate analyses of the inland and ocean fleets.

* Table 5 follows on p. 9.
** Table 6 follows on p. 10.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 5

Estimated Consumption of Petroleum Products
by Civil Air Transport in the USSR, by Type of Product a/
1945-55

Thousand Metric Tons

Year	Gasoline	Lubricants	Total
1945	153	3	156
1946	176	3	179
1947	194	4	198
1948	215	4	219
1949	236	4	240
1950	268	5	273
1951	305	6	311
1952	343	6	349
1953	380	7	387
1954	418	8	426
1955	450	8	458

a. Data in this table have been compiled from Tables 10 through 20, Appendix A.

For each fleet, it has been necessary to examine the composition, to estimate the horsepower of the petroleum-fueled units, and to distribute the horsepower according to the type of petroleum fuel used. Because only a part of the fleet is serviceable throughout the year, the degree of serviceability has been calculated. Other factors, such as the length of the navigation season and average time under way and at anchor, are also analyzed. By these procedures is calculated the number of horsepower-hours in use while under way and at anchor for each type of fuel consumed in each fleet. Applying petroleum fuel consumption factors per horsepower-hour under way and at anchor yields estimates of consumption for each type of petroleum product. Estimates of consumption of lubricants are obtained by applying a consumption factor to the annual serviceable horsepower of all vessels in both fleets. (Details of these calculations are presented in Appendix B, Section 4.)

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 6

Estimated Consumption of Petroleum Products
by Water Transport in the USSR, by Type of Product a/
1945-55

Thousand Metric Tons

Year	Gasoline	Diesel Fuel	Residual Fuel Oil	Lubricants	Total
1945	2	297	1,484	59	1,842
1946	8	321	1,568	61	1,958
1947	14	346	1,658	64	2,082
1948	21	370	1,741	67	2,199
1949	27	396	1,831	69	2,323
1950	32	420	1,915	73	2,440
1951	39	445	2,004	76	2,564
1952	44	475	2,247	83	2,849
1953	50	545	2,523	94	3,212
1954	54	632	2,710	104	3,500
1955	58	726	2,827	114	3,725

a. Data in this table have been compiled from Tables 10 through 20, Appendix A.

The final computation of petroleum consumption, by type of product, depends on a series of factors, each of which may be assumed to have a fairly small range of error. The cumulative effect of these errors, however, is estimated to be plus or minus 25 percent for petroleum fuels, and plus or minus 15 percent for lubricants.

VI. Agriculture.

Estimated consumption of petroleum products by agriculture in the USSR, by type of product, 1945-55, is shown in Table 7.* The estimates are based principally on an analysis of agricultural tractors and combines. Also included are estimates of consumption by all other agricultural machinery -- threshers, mechanized potato diggers, self-propelled mowers, cotton-picking machines, and the like.

* Table 7 follows on p. 11.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 7

Estimated Consumption of Petroleum Products
by Agriculture in the USSR, by Type of Product a/
1945-55

Thousand Metric Tons

Year	Gasoline	Ligroin	Kerosine	Diesel Fuel	Lubricants	Total
1945	172	b/	b/	b/	208	3,275
1946	197	b/	b/	b/	246	3,895
1947	330	561	3,716	65	313	4,985
1948	412	556	4,531	247	386	6,132
1949	518	470	4,845	683	427	6,943
1950	619	439	4,889	1,272	461	7,680
1951	797	436	5,178	1,722	510	8,643
1952	925	474	4,809	2,623	538	9,369
1953	1,051	544	4,837	3,734	606	10,772
1954	1,135	239	4,657	5,291	651	11,973
1955	1,298	0	4,536	7,438	737	14,009

a. Data in this table have been compiled from Tables 10 through 20, Appendix A.
b. Insufficient data preclude separate estimates.

Consumption of petroleum products by agricultural tractors has been estimated by multiplying the average consumption of petroleum fuel per hectare (2.471 acres) by the number of hectares of tractor work performed. Consumption of lubricants by tractors has been estimated on the basis of its relationship to fuel consumption. Fortunately, Soviet sources have supplied all the factors necessary for making these calculations for agricultural tractors. The task has been simplified by the Soviet statistical procedure wherein tractor performance for all types of tractor work is expressed in a standard accounting unit -- the hectare of soft plowing. This practice obviates the necessity of taking into account the effect on fuel consumption of different types of tractor work.

Consumption of petroleum products by agricultural combines has been estimated by a method similar to that used for consumption by

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

tractors. By multiplying the number of hectares harvested by combines by a factor of fuel consumption per hectare gives the consumption of petroleum fuel by combines. The problem is somewhat simplified by the fact that all known operating combine models are fueled with gasoline. Of the four models in use in the USSR, three are drawn by tractors. Gasoline consumption by such combines applies only to the combine mechanism itself; fuel consumed by the tractors is included in tractor consumption. One of the combine models is self-propelled. Its fuel consumption per hectare harvested, therefore, is more than twice that of the tractor-drawn models.

In calculating consumption of petroleum fuel by combines, the different consumption rates per hectare harvested by the tractor-drawn and self-propelled models have been taken into account. The total hectares harvested have been subdivided according to the estimated numbers and productivities of the different combine models in the Soviet park. In this procedure, use has been made of Soviet data concerning the productivity of the different models of combines. Implicit in these calculations is the assumption that each combine model is in operation for an equal period of time during the year. Estimates of consumption of lubricants have been computed on the basis of consumption of fuel.

It has not been possible to estimate separately consumption of petroleum by all other mechanized agricultural machinery. Soviet sources have provided many indications that mechanization of agriculture has advanced considerably beyond the use of tractors and combines only. It is likely, however, that the numbers of other mechanical sowing and harvesting devices, in comparison with tractors and combines, is small during the 1945-55 period. Of these devices, probably the largest number is threshers, which consume petroleum fuel and lubricants at about the same rate as tractor-drawn combines. To include consumption of petroleum products by all these other mechanical units, the consumption estimates have been increased by 30 percent. (All details of estimates of consumption of petroleum by Soviet agriculture are presented in Appendix B, Section 5.)

In view of the fact that estimates of consumption by agricultural tractors have been derived from Soviet sources, the range of error to which they are subject is believed to be not more than plus or minus 5 percent. That for estimates of consumption by agricultural combines is not believed to exceed plus or minus 15 percent, but for all others it may be as high as plus or minus 50 percent. The

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

cumulative effect of these errors is considered to be less than plus or minus 10 percent.

VII. Households.

Consumption of petroleum products by Soviet households is believed to consist almost entirely of kerosine, which is used for lighting and cooking. Other petroleum products, undoubtedly, are used for domestic purposes of various kinds, but the amounts must be negligible. Estimated consumption of kerosine in households in the USSR, 1945-55, is given in Table 8.*

Postwar Soviet data concerning the consumption of kerosine by the Soviet civil economy are nonexistent. Estimates of consumption of lamp kerosine, therefore, have been based on two basic assumptions: (a) the dominant source of light in nonelectrified rural dwellings is kerosine lamps, and (b) the dominant source of light in urban dwellings is derived from electricity. Given the number of nonelectrified rural dwellings, and assuming an average length of time each lamp burns per year, it has been possible to estimate consumption of lamp kerosine.

In estimating consumption of stove kerosine in the USSR, it has not been entirely necessary to depend on partially verified assumptions. In late 1953 the USSR announced production goals for kerosine stoves. By applying conservative use and consumption factors, the goal figures have been used to estimate consumption of stove kerosine. (Details underlying these computations are given in Appendix B, Section 6.)

The margin of error of estimates of consumption of petroleum products by the households sector is most difficult to estimate. It is believed that the methodology used is sound. In addition it is believed that the methodology is the only one feasible. On the other hand, none of the factors involved has been completely verified. Finally, production data on kerosine stoves for 1954 and 1955 are plan goals, from which data for previous years must be inferred. An estimated margin of error for these estimates is placed hesitatingly at plus or minus 25 percent.

* Table 8 follows on p. 14.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 8

Estimated Consumption of Kerosine
in Households in the USSR a/
1945-55

Thousand Metric Tons

Year	Lamp Kerosine	Stove Kerosine	Total
1945	1,440	400	1,840
1946	1,436	450	1,886
1947	1,432	500	1,932
1948	1,426	600	2,026
1949	1,421	750	2,171
1950	1,417	900	2,317
1951	1,453	1,245	2,698
1952	1,483	1,680	3,163
1953	1,512	2,220	3,732
1954	1,547	3,114	4,661
1955	1,575	4,140	5,715

a. Data in this table have been compiled from Tables 33 and 34, Appendix B.

VIII. Industry.

Estimated consumption of petroleum by industry in the USSR, by type of product, 1945-55, is shown in Table 9.* Estimates of the petroleum distillates (gasoline, ligroin, kerosine, and diesel fuel) consumed by industry have been based on the relationship of the agricultural tractor park to the total tractor park. (For the purposes of this report, all tractors not in the agricultural park are placed in the industry tractor park.) Consumption of petroleum distillates by the nonagricultural tractor park has been increased by an arbitrary factor of 10 percent to allow for consumption in machinery other than tractors. Estimates of industrial consumption of residuals and lubricants have been made by estimating total supply (production plus imports minus exports) and then deducting

* Table 9 follows on p. 15.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 9

Estimated Consumption of Petroleum Products by Industry in the USSR, by Type of Product a/ 1945-55

Thousand Metric Tons

Year	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
1945	6		277 b/		2,480	489	3,252
1946	7		330 b/		3,144	555	4,036
1947	8	54	355	6	3,958	644	5,025
1948	11	61	493	28	4,846	714	6,153
1949	14	53	527	74	5,980	852	7,500
1950	26	78	876	228	7,114	992	9,314
1951	45	112	1,100	680	8,034	1,106	11,077
1952	72	175	1,100	1,624	9,554	1,262	13,787
1953	81	188	1,100	1,878	10,400	1,379	15,026
1954	95	84	1,100	2,356	12,087	1,682	17,404
1955	109	0	1,100	2,836	13,756	1,909	19,710

a. Data in this table have been compiled from Tables 10 through 20, Appendix A.
b. An aggregate figure including ligroin, kerosine, and diesel fuel.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

estimated consumption by other sectors and making an additional deduction for peacetime military consumption. It has been assumed that the remainder is consumed by industry. (See Appendix B, Section 7, for a more complete description of this method as well as a discussion of alternative methods.)

The margin of error inherent in the results obtained from the methodology outlined above is difficult to estimate, particularly with respect to residuals and lubricants. For estimates of consumption of distillates, however, it is believed that the primary methodology is reasonably adequate, even though too small an allowance for nontractor uses may have been made. The margin of error for distillates consumption by industry is, therefore, estimated at minus 10 percent to plus 25 percent. Although estimates of consumption of residuals and lubricants have been derived by difference between total consumption (excluding industry) and total supply, the margin of error can hardly exceed plus or minus 20 percent, for the bulk of the petroleum products involved in this estimate is residuals, principally residual fuel oil. The major use, and about the only use, to which residual fuel oil can be put is boiler fuel. Of the other consuming sectors, only water and rail transport use boiler fuel. Inasmuch as residual fuel oil is of necessity a residue of petroleum refining operations, the industrial sector is the only remaining sector of the economy that can consume it in large quantities.

IX. Conclusions.

Consumption of petroleum products by the civil economy of the USSR from 1945 through 1953 is estimated to have increased slightly over 16 percent per year. This trend and the 1955 petroleum production goal of the Fifth Five Year Plan indicate that the average annual increases in 1954 and 1955 will be somewhat less, about 13 percent. For comparison, the average annual increase in domestic demand for petroleum products in the US from 1945 through 1953 was 5.8 percent. For 1954 and 1955, annual increases in the US are forecast at from 3 percent to 3.5 percent. 1/*

The over-all growth of consumption of petroleum products by sectors of the Soviet civil economy over the 1945-55 period is shown

* Footnote references in arabic numerals are to sources listed in Appendix D.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

in Chart 1.* Of the seven sectors, industry -- except in 1945 -- has been the largest consumer. Agriculture, which was the largest consumer in 1945, has been the second largest since that year. Although motor transport has shown a faster rate of growth from 1945 through 1953, the trend indicates that in 1954 and 1955 industry and agriculture will continue to remain the largest petroleum-consuming sectors in the civil economy, with motor transport third.

The consumer goods program that began in the last half of 1953 is believed to affect consumption of petroleum noticeably in only two sectors of the civil economy, agriculture and households. From 1949 through 1954, consumption of petroleum products by agriculture, relative to total civilian consumption, is estimated to have decreased steadily, dropping from 29 percent in 1948 to 25 percent in 1954. Although tractor deliveries to agriculture were stepped up in 1953, this downward trend probably will not be arrested until 1955. It is estimated that in that year consumption by agriculture will be about 26 percent of the total civil consumption.

Consumption of petroleum products, principally kerosine, by Soviet households from 1945 through 1953 is estimated to have declined regularly from 15 percent of the total civil consumption in 1945 to about 8 percent in 1952. As a result of the consumer goods program, more kerosine stoves, and probably lamps as well, are scheduled to be available for 1954 and 1955. In addition, a 38-percent price reduction in kerosine for lighting was to have been effective on 1 April 1954. 2/ Accordingly, consumption of kerosine by Soviet households is estimated to increase to more than 10 percent of the total civil consumption by 1955.

The estimated growth of civil consumption of petroleum products, by type of product, for the 1945-55 period is shown in Chart 2.** Consumption of each product, with the exception of ligroin, has been increasing and is estimated to continue increasing through 1955. Throughout the period, growth of consumption of gasoline has been rapid. Beginning in 1950, however, consumption of diesel fuel began to increase at a faster rate. This increase stems principally from the greater use of diesel tractors in agriculture. Other sectors in which consumption of diesel fuel is increasing are industry and rail and water transport.

* Following p. 18.
** Following p. 18.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Although the quantities of petroleum products consumed by the Soviet military forces are not included in the estimates, the consumption pattern by type of product, shown in Chart 2, indicates that there has been no marked change in Soviet refining practices over the 1945-55 period. There is indicated, however, a gradual trend toward increasing the yield of distillate products (gasoline, kerosine, and diesel fuel) and decreasing the yield of residuals. From 1952 forward, the increase appears to be concentrated more in the middle-distillate range than in the gasoline range. In view of the rapidly rising civil consumption of distillates, it is to be expected that the trend toward maximizing their yields will continue.

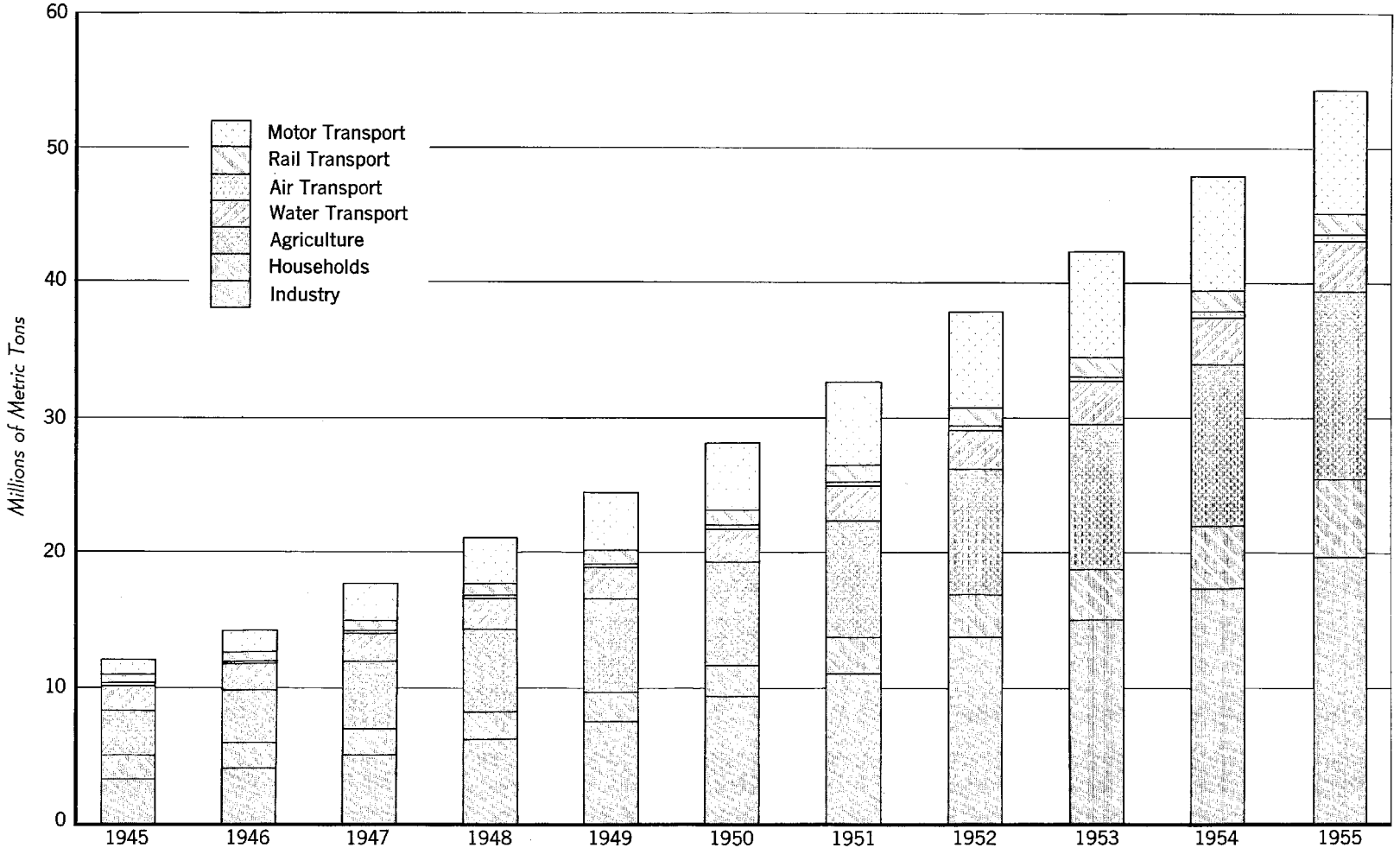
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Chart 1

USSR

ESTIMATED CIVIL CONSUMPTION OF PETROLEUM PRODUCTS, 1945-55
BY CONSUMING SECTOR



13435 CIA, 9-54

US Officials Only

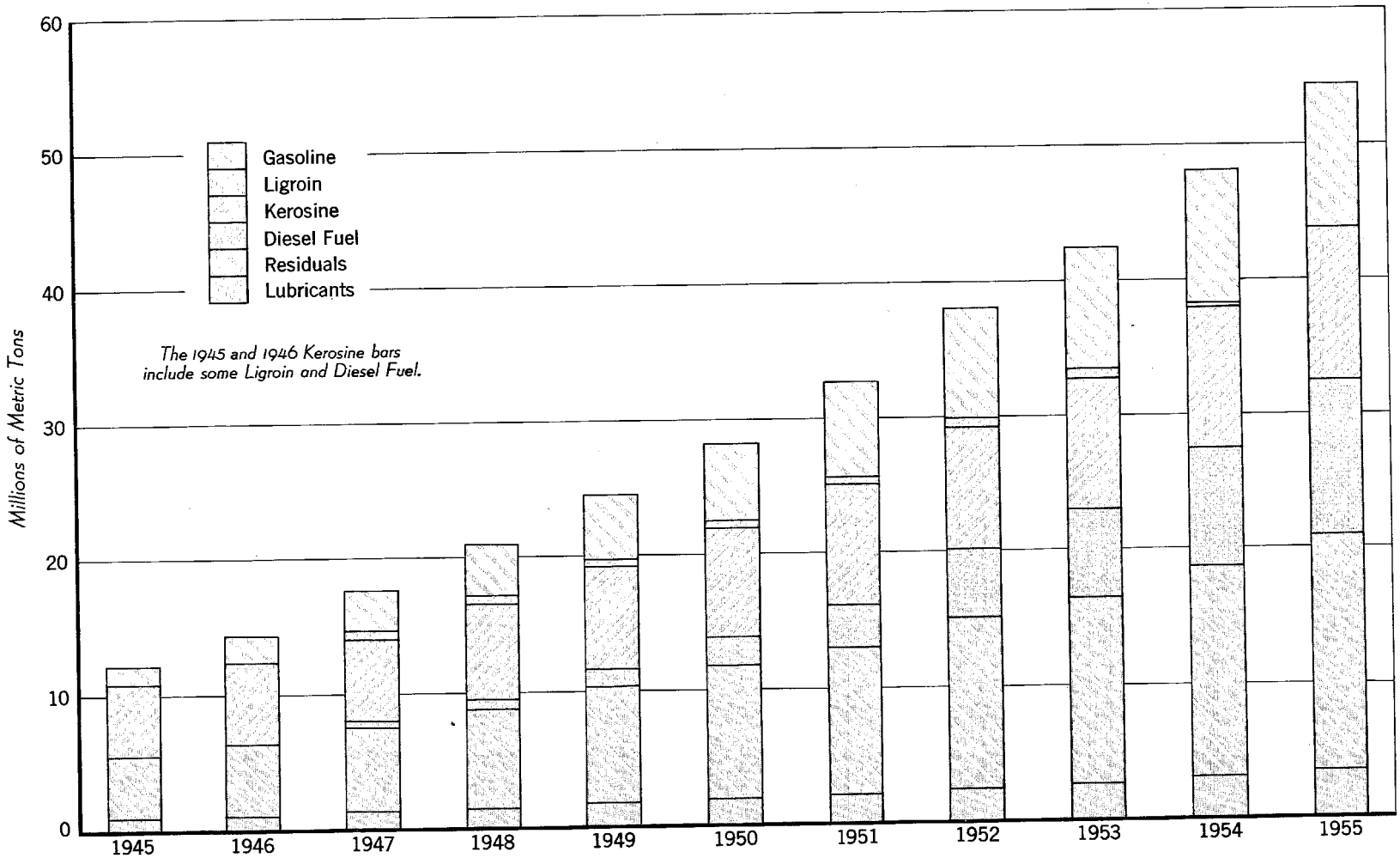
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Chart 2

USSR

ESTIMATED CIVIL CONSUMPTION OF PETROLEUM PRODUCTS, 1945-55
BY TYPE OF PRODUCT



13434 CIA, 9-54

US Officials Only

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

APPENDIX A

ESTIMATED ANNUAL CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR, BY TYPE OF PRODUCT AND BY CONSUMING SECTOR

This Appendix consists of Tables 10 through 20. Each table shows the estimated civil consumption of petroleum products for one of the years in the 1945-55 period, by type of product and by consuming sector. The methods and calculations used for estimating the consumption of each sector are described in Appendix B, which treats each sector in the order followed by the tables.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 10

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1945

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	1,045	Negligible a/	Negligible	Negligible	0	52	1,097
Rail Transport	Negligible	Negligible	Negligible	33	564	51	648
Air Transport	153	0	Negligible	0	0	3	156
Water Transport	2	0	Negligible	297	1,484	59	1,842
Agriculture	172		2,895 b/		Negligible	208	3,275
Households	Negligible	Negligible	1,840	Negligible	Negligible	Negligible	1,840
Industry	6		277 b/		2,480	489	3,252
Total	1,378		5,342	330	4,528	862	12,110

a. Negligible quantities are less than 0.5 percent of the product total.
b. Aggregate figure for ligroin, kerosine, and diesel fuel.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 11

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1946

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	1,520	Negligible a/	Negligible	Negligible	0	76	1,596
Rail Transport	Negligible	Negligible	Negligible	39	594	54	687
Air Transport	176	0	Negligible	0	0	3	179
Water Transport	8	0	Negligible	321	1,568	61	1,958
Agriculture	197		3,452 b/		Negligible	246	3,895
Households	Negligible	Negligible	1,886	Negligible	Negligible	Negligible	1,886
Industry	7		330 b/		3,144	555	4,036
Total	1,908		6,028	360	5,306	995	14,237

a. Negligible quantities are less than 0.5 percent of the product total.
b. Aggregate figure for ligroin, kerosine, and diesel fuel.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 12

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1947

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	2,566	Negligible a/	Negligible	Negligible	0	128	2,694
Rail Transport	Negligible	Negligible	Negligible	53	594	55	702
Air Transport	194	0	Negligible	0	0	4	198
Water Transport	14	0	Negligible	346	1,658	64	2,082
Agriculture	330	561	3,716	65	Negligible	313	4,985
Households	Negligible	Negligible	1,932	Negligible	Negligible	Negligible	1,932
Industry	8	54	355	6	3,958	644	5,025
Total	3,112	615	6,003	470	6,210	1,208	17,618

a. Negligible quantities are less than 0.5 percent of the product total.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 13

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1948

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	3,160	Negligible a/	Negligible	Negligible	0	158	3,318
Rail Transport	Negligible	Negligible	Negligible	79	712	67	858
Air Transport	215	0	Negligible	0	0	4	219
Water Transport	21	0	Negligible	370	1,741	67	2,199
Agriculture	412	556	4,531	247	Negligible	386	6,132
Households	Negligible	Negligible	2,026	Negligible	Negligible	Negligible	2,026
Industry	11	61	493	28	4,846	714	6,153
Total	3,819	617	7,050	724	7,299	1,396	20,905

a. Negligible quantities are less than 0.5 percent of the product total.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 14

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1949

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	4,039	Negligible a/	Negligible	Negligible	0	202	4,241
Rail Transport	Negligible	Negligible	Negligible	128	806	80	1,014
Air Transport	236	0	Negligible	0	0	4	240
Water Transport	27	0	Negligible	396	1,831	69	2,323
Agriculture	518	470	4,845	683	Negligible	427	6,943
Households	Negligible	Negligible	2,171	Negligible	Negligible	Negligible	2,171
Industry	14	53	527	74	5,980	852	7,500
Total	4,834	523	7,543	1,281	8,617	1,634	24,432

a. Negligible quantities are less than 0.5 percent of the product total.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 15

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1950

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	4,776	Negligible a/	Negligible	Negligible	0	239	5,015
Rail Transport	Negligible	Negligible	Negligible	191	849	89	1,129
Air Transport	268	0	Negligible	0	0	5	273
Water Transport	32	0	0	420	1,915	73	2,440
Agriculture	619	439	4,889	1,272	Negligible	461	7,680
Households	Negligible	Negligible	2,317	Negligible	Negligible	Negligible	2,317
Industry	26	78	876	228	7,114	992	9,314
Total	5,721	517	8,082	2,111	9,878	1,859	28,168

a. Negligible quantities are less than 0.5 percent of the product total.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 16

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1951

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	5,845	Negligible a/	Negligible	Negligible	0	292	6,137
Rail Transport	Negligible	Negligible	Negligible	264	897	100	1,261
Air Transport	305	0	Negligible	0	0	6	311
Water Transport	39	Negligible	Negligible	445	2,004	76	2,564
Agriculture	797	436	5,178	1,722	Negligible	510	8,643
Households	Negligible	Negligible	2,698	Negligible	Negligible	Negligible	2,698
Industry	45	112	1,100	680	8,034	1,106	11,077
Total	7,031	548	8,976	3,111	10,935	2,083	32,691

a. Negligible quantities are less than 0.5 percent of the product total.

Table 17

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1952

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	6,724	Negligible a/	Negligible	Negligible	0	336	7,060
Rail Transport	Negligible	Negligible	Negligible	344	916	109	1,369
Air Transport	343	0	Negligible	0	0	6	349
Water Transport	44	0	Negligible	475	2,247	83	2,849
Agriculture	925	474	4,809	2,623	Negligible	538	9,369
Households	Negligible	Negligible	3,163	Negligible	Negligible	Negligible	3,163
Industry	72	175	1,100	1,624	9,554	1,262	13,787
Total	8,108	649	9,072	5,066	12,717	2,334	37,946

a. Negligible quantities are less than 0.5 percent of the product total.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 18

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1953

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	7,366	Negligible a/	Negligible	Negligible	0	368	7,734
Rail Transport	Negligible	Negligible	Negligible	432	911	117	1,460
Air Transport	380	0	Negligible	0	0	7	387
Water Transport	50	0	Negligible	545	2,523	94	3,212
Agriculture	1,051	544	4,837	3,734	Negligible	606	10,772
Households	Negligible	Negligible	3,732	Negligible	Negligible	Negligible	3,732
Industry	81	188	1,100	1,878	10,400	1,379	15,026
Total	8,928	732	9,669	6,589	13,834	2,571	42,323

a. Negligible quantities are less than 0.5 percent of the product total.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 19

Estimated Civil Consumption of Petroleum products in the USSR
by Type of Product and by Consuming Sector
1954

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	8,078	Negligible a/	Negligible	Negligible	0	404	8,482
Rail Transport	Negligible	Negligible	Negligible	521	890	123	1,534
Air Transport	418	0	Negligible	0	0	8	426
Water Transport	54	0	Negligible	632	2,710	104	3,500
Agriculture	1,135	239	4,657	5,291	Negligible	651	11,973
Households	Negligible	Negligible	4,661	Negligible	Negligible	Negligible	4,661
Industry	95	84	1,100	2,356	12,087	1,682	17,404
Total	9,780	323	10,418	8,800	15,687	2,972	47,980

a. Negligible quantities are less than 0.5 percent of the product total.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 20

Estimated Civil Consumption of Petroleum Products in the USSR
by Type of Product and by Consuming Sector
1955

Thousand Metric Tons

Consuming Sector	Gasoline	Ligroin	Kerosine	Diesel Fuel	Residuals	Lubricants	Total
Motor Transport	8,697	Negligible a/	Negligible	Negligible	0	435	9,132
Rail Transport	Negligible	NNegligible	Negligible	625	836	128	1,589
Air Transport	450	0	Negligible	0	0	8	458
Water Transport	58	0	Negligible	726	2,827	114	3,725
Agriculture	1,298	0	4,536	7,438	Negligible	737	14,009
Households	Negligible	Negligible	5,715	Negligible	Negligible	Negligible	5,715
Industry	109	0	1,100	2,836	13,756	1,909	19,710
Total	10,612		11,351	11,625	17,419	3,331	54,338

a. Negligible quantities are less than 0.5 percent of the product total.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

APPENDIX B

METHODOLOGY

Although the methodology used for estimating consumption of petroleum products by the Soviet civil economy differs from one consuming sector to another, in most cases published Soviet data form the basis for the estimates. For each consuming sector the description of the methods used takes the form of one or more tables.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 21

Estimated Consumption of Petroleum Products by Motor Transport in the USSR
1945-55

Year	(1) Ton-Kilometers a/ (Billions)	(2) Gasoline Consumption b/ (Metric Tons per Ton-Kilometer)	(3) Gasoline Consumption for Hauling Freight c/ (Thousand Metric Tons)	(4) Percentage of Total Distance Travelled by Loaded Trucks d/	(5) Gasoline Consumption for Empty Runs e/ (Thousand Metric Tons)	(6) Subtotal (Truck Consumption) f/ (Thousand Metric Tons)	(7) Gasoline Consumption by All Others g/ (10 (Percent of Subtotal) (Thousand Metric Tons)	(8) Total Gasoline Consumption h/ (Thousand Metric Tons)	(9) Lubricant Consumption i/ (5 Percent of Fuel)	(10) Total Petroleum j/ (Thousand Metric Tons)
1945	4.4	.000120	528	50	422	950	95	1,045	52	1,097
1946	6.4	.000120	768	50	614	1,382	138	1,520	76	1,596
1947	10.8	.000120	1,296	50	1,037	2,333	233	2,566	128	2,694
1948	13.3	.000120	1,596	50	1,277	2,873	287	3,160	158	3,318
1949	17.0	.000120	2,040	50	1,632	3,672	367	4,039	202	4,241
1950	20.1	.000120	2,412	50	1,930	4,342	434	4,776	239	5,015
1951	24.6	.000120	2,952	50	2,362	5,314	531	5,845	292	6,137
1952	28.3	.000120	3,396	50	2,717	6,113	611	6,724	336	7,060
1953	31.0	.000120	3,720	50	2,976	6,696	670	7,366	368	7,734
1954	34.0	.000120	4,080	50	3,264	7,344	734	8,078	404	8,482
1955	36.6	.000120	4,392	50	3,514	7,906	791	8,697	435	9,132

a. Ton-kilometers for the years 1945-49 are from source 3/. Those for 1950-55 are from source 4/.

b. The gasoline consumption per ton-kilometer figure given in source 5/ is .000126 metric tons. (All tonnage references are to metric tons.) It is based on the performance of a number of ZIS-150 stake trucks engaged in construction work in the Moscow area. For comparison, an average gasoline consumption per ton-kilometer for the months of November and December of 1953 for the entire truck-transport fleet in East Germany was calculated from data contained in source 6/. For November the factor was, in gasoline equivalents, .000099 and for December it was .000101. Inasmuch as about one-third of the ton-kilometers performed was by more efficient diesel-fueled vehicles, of which the USSR has very few, it is believed that the fuel consumption factor is somewhat lower than the USSR average. On the other hand, it does indicate that the performance factor derived from the ZIS-150's in construction work may be a little high. The factor of .000120 tons of gasoline per ton-kilometer used in this research aid represents a compromise between these two figures.

c. By definition, ton-kilometers represent only the freight hauled multiplied by the distance traversed. Therefore, gasoline consumption, obtained by multiplying ton-kilometers by the gasoline consumption per ton-kilometer represents only the amount of gasoline consumed in hauling freight.

d. 7/

e. In c, above, the gasoline consumed by trucks hauling freight has been calculated. In order to calculate total gasoline consumption by truck transport, it is necessary to determine also the quantity of gasoline consumed by trucks that ran without loads. This quantity was arrived at by the following calculation:

Let G_L = gasoline consumed in hauling freight

G_E = gasoline consumed in running empty

G_T = Total gasoline consumed by trucks

Then $G_T = G_L + G_E$ (equation 1)

Let G_L = gasoline consumed per kilometer traversed with a freight load

D = total distance traversed by all trucks

Then $G = .50 (F_L)D$ (equation 2)

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 21

Estimated Consumption of Petroleum Products by Motor Transport in the USSR
1945-55
(Continued)

From Table 21, we have concluded that in 1953 G_L = 3,720,000 tons. Substituting this quantity in equation 2 we have:

$$3{,}720{,}000 = .50D\ (F_L) \quad \text{(equation 3)}$$

Solving for D, we get $D = \frac{7{,}440{,}000}{F_L}$

Let $k(F_L)$ = fuel consumed per kilometer by unloaded trucks

Then $G_E = .50D \times k(F_L)$ (equation 4)

Substituting the value for D, obtained in equation 3, in equation 4, we get:

$$G_E = .50 \left(\frac{7{,}440{,}000}{F_L}\right) \times k\ (F_L) \quad \text{(equation 5)}$$

$$G_E = 3{,}720{,}000 \times k$$

In source 8/ the gasoline consumed by a vehicle running empty averages about 80 percent of that consumed by a loaded one. Then

$$k = .8$$

Substituting the value for k in equation 5,

$$G_E = 2{,}976{,}000 \text{ metric tons.}$$

f. See equation 1 above.

g. In addition to gasoline consumed by trucks making and returning from freight hauls is such other consumption as (1) the gasoline consumed in intragarage and repair operations and (2) the gasoline consumed by passenger vehicles. It is estimated that the gasoline consumed in intragarage and repair operations is about 2 percent of the total gasoline consumed in transport operations. 9/ Although the passenger vehicle fleet may be as large as 10 percent of the truck fleet, average gasoline consumption per passenger vehicle is believed to be somewhat less than that of the average truck. Gasoline consumption by "all others" is, therefore, estimated to average about 10 percent of the quantity consumed by trucks in transport activities.

h. Obtained by adding figures in columns 6 and 7.

i. 10/

j. The total petroleum consumption by motor vehicles in the USSR, as determined in this paper, checks rather well with other data. In source 11/ a gasoline consumption figure of .0002774 tons per ton-kilometer was derived, principally from Soviet sources, for the year 1936. Known to be included in this figure is gasoline consumed by trucks running without loads. It is believed that this figure also includes gasoline consumed by passenger vehicles. Actually, then, the .0002774 tons per ton-kilometer is not related solely to truck performance. Taking the total gasoline consumption for the year 1950, as calculated in Table 21, however, and relating it to the ton-kilometer figure, as given in source 12/ for that year, we can reproduce the same relationship. In 1950 this relationship (total gasoline consumption by motor vehicles to ton-kilometers) works out to .0002376 tons. Compared with the 1936 figure, the 1950 one is about 14 percent lower, which may be explained by increased efficiency and improved technology. Such increases and improvements result from higher compression ratios in the automotive engines, higher octane ratings of the gasoline, larger freight-carrying trucks, more miles of hard-surfaced roads, and better trained and higher skilled transportation workers and drivers. Since 1936, these advances logically would lead to lower consumption per ton-kilometer, providing the relationship between the number of trucks and the number of automobiles had not changed significantly. It is to be noted that available evidence does not indicate that there has been any significant change in this relationship since 1936. The total motor vehicle park (excluding tractors and similar vehicles) is believed to have comprised about the same percentage of trucks and passenger vehicles as in 1936.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 22

Estimated Consumption of Petroleum Products by Rail Transport in the USSR
1945-55

Year	(1) Ton-Kilometers Freight a/ (Billions)	(2) Performance Index b/ (1951 = 100)	(3) Consumption of Petroleum Fuels c/ (Thousands of Metric Tons of Standard Fuel)	(4) Consumption of Diesel Fuel d/ (Thousands of Metric Tons of Standard Fuel)	(5) Consumption of Residual Fuel Oil e/ (Thousands of Metric Tons of Standard Fuel)	(6) Diesel Fuel Consumption f/ (Thousand Metric Tons)	(7) Residual Fuel Oil Consumption g/ (Thousand Metric Tons)	(8) Lubricant Consumption h/ (Thousand Metric Tons)	(9) Total Consumption of Petroleum i/ (Thousand Metric Tons)
1945	347.6	50.7	857	51	806	33	564	51	648
1946	368.0	53.7	908	60	848	39	594	54	687
1947	377.8	55.1	931	82	849	53	594	55	702
1948	462.2	67.4	1,139	122	1,017	79	712	67	858
1949	540.8	79.8	1,349	198	1,151	128	806	80	1,014
1950	612.0	89.3	1,509	296	1,213	191	849	89	1,129
1951	685.4	100.0	1,690	409	1,281	264	897	100	1,261
1952	747.1	109.0	1,842	533	1,309	344	916	109	1,369
1953	799.4	116.6	1,971	670	1,301	432	911	117	1,460
1954	843.4	123.1	2,080	808	1,272	521	890	123	1,534
1955	877.1	128.0	2,163	969	1,194	625	836	128	1,589

a. Ton-kilometers of freight for 1945-50 are from source 13/. Those for 1951-55 are from source 14/.
b. Conversion of ton-kilometers of freight to the 1951 base.
c. Source 15/ estimates that the Soviet railroads consumed about 76.14 million tons of coal. On the basis of the 1946 percentage distribution of railroad fuel, source 16/ also estimates that the standard fuel consumed by the railroads in 1951 was 97.3 percent coal, 2.5 percent fuel oil, and .2 percent other fuels. Since coal has about 88.7 percent of the calorific value of standard fuel, the total fuel consumption in standard fuel units of the Soviet railroads is calculated to have been 67.54 million tons. Inasmuch as 2.5 percent of this total was petroleum fuels, the total petroleum fuel consumption in 1951 was 1,690,000 tons of standard fuel. Assuming that the ratio of petroleum fuel to total fuel consumed by the railroads remained constant over the 1945-55 period (and there is no evidence to indicate that there has been a significant change), applying the performance index to the 1951 quantity gives a series of petroleum fuel consumption figures for 1945-55 in standard fuel units.
d. Consumption of diesel fuel in standard fuel units was obtained by multiplying the number of diesel engines in the Soviet locomotive park each year by the annual consumption of diesel fuel by a diesel engine. The number of diesel engines in the park was taken from source 17/. The annual consumption of diesel fuel per diesel locomotive was taken from source 18/. This source indicates that each diesel engine consumes about 350 tons of diesel fuel per year. The quantities so obtained were converted into standard fuel units by multiplying them by 1.55 (the calorific value of diesel fuel is 55 percent greater than that of standard fuel).
e. Obtained by subtracting the figure in column (4) form that in column (3).
f. See d. above.
g. Converted from standard fuel by multiplying figure in column (5) by .70 (the calorific value of standard fuel is only 70 percent of that of residual fuel oil).
h. Source 19/ estimates that the Soviet railroads consumed 100,000 tons of lubricants in 1951. Assuming that the ratio between lubricant consumption and performance is constant over the 1945-55 period, applying the performance index (column 2) to the 1951 estimate gives the 1945-55 lubricant consumption series.
i. Sum of figures in columns (6), (7), and (8).

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 23

Estimated Consumption of Petroleum Products
by Civil Air Transport in the USSR, by Type of Product
1945-55

Thousand Metric Tons

Year	Aviation Gasoline a/	Lubricants b/	Subtotal	Losses (Evaporation, Handling, etc.) c/	Total
1945	143	3	146	10	156
1946	164	3	167	12	179
1947	181	4	185	13	198
1948	201	4	205	14	219
1949	220	4	224	16	240
1950	250	5	255	18	273
1951	285	6	291	20	311
1952	320	6	326	23	349
1953	355	7	362	25	387
1954	390	8	398	28	426
1955	420	8	428	30	458

a. Estimates for 1945-49 were taken from source 20/. Those for 1950-55 are essentially projections of these figures, with a somewhat faster rate of increase included in view of the increasing production of aircraft.

b. Lubricant consumption factor of 2 percent of the fuel, derived from US experience. 21/

c. Losses (evaporation, handling, etc.) are estimated at 7 percent of the total fuels and lubes. Normal losses in the US average about 4 percent, but in places like Karachi, for example, such losses run as high as 10 percent to 15 percent. It is believed, therefore, that the Soviet losses probably lie somewhere between these two extremes. 22/

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

The methods and sources used in estimating consumption of petroleum products by water transport in the USSR are described in Tables 24 through 28. The primary methodology for these estimates is contained in the footnotes to Table 24. Resulting from this methodology are petroleum consumption estimates for 1946 and 1951 only. Using data contained in source 23/, it has been possible to estimate separately the consumption of diesel fuel by water transport for the years 1952 through 1955. Estimates of diesel fuel consumption by the inland fleet are contained in Table 25 and those of the ocean fleet are in Table 26. Consumption estimates of other petroleum fuels for 1952 through 1955 are based on percentage increases in performance (ton-kilometers), using as a base the 1951 relationship among the fuels. These estimates are detailed in Table 27. All petroleum consumption data derived in Tables 24 through 27 are summarized in Table 28.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

S-E-C-R-E-T

Table 24

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product and by Type of Fleet 23/
1946 and 1951

Type of Consuming Equipment	(1) Total Horsepower a/*	(2) Percent of Fleet Serviceable b/	(3) Serviceable Horsepower c/	(4) Average Number of Hours Under Way d/	(5) Average Number of Hours at Anchor e/	(6) Horsepower-Hours Under Way f/ (Thousands)	(7) Horsepower-Hours at Anchor g/ (Thousands)	(8) Petroleum Consumption per Horsepower-Hour Under Way h/ (Metric Tons)	(9) Petroleum Consumption Under Way i/ (Thousand Metric Tons)	(10) Petroleum Consumption per Horsepower-Hour at Anchor j/ (Metric Tons)	(11) Petroleum Consumption at Anchor k/ (Thousand Metric Tons)	(12) Total Petroleum Fuel Consumption l/ (Thousand Metric Tons)	(13) Lubricating Oil Consumption per Horsepower-Hour m/ (Metric Tons)	(14) Lubricating Oil Consumption n/ (Thousand Metric Tons)	(15) Total Petroleum Consumption o/ (Thousand Metric Tons)
1946															
Inland Fleet															
Gasoline	17,928		13,446	2,679	1,083	36,022	14,562	.000227	8	.000006	p/	8	.000007	p/	8
Diesel Fuel	59,760		44,820	2,679	1,083	120,073	48,540	.000213	26	.000005	p/	26	.000007	1	27
Residual Fuel Oil	370,512		277,884	2,679	1,083	744,451	300,948	.001090	811	.000164	49	860	.000006	6	866
Coal	89,640		67,230	2,679	1,083	180,109	72,810						.000006	1	1
Total Inland (1946)	537,840	75	403,380			1,080,655	436,860		845		49	894		8	902
Ocean Fleet															
Diesel Fuel	450,000	q/	450,000	2,661	3,123	1,197,440	1,405,350	.000200	239	.000040	56	295	.000007	18	313
Residual Fuel Oil	374,000	q/	374,000	2,661	3,123	995,214	1,168,002	.000571	568	.000120	140	708	.000006	13	721
Coal	646,600	q/	646,600	2,661	3,123	1,720,603	2,019,331						.000006	22	22
Total Ocean (1946)	1,470,600		1,470,600			3,895,257	4,592,683		807		196	1,003		53	1,056
Total (1946)	2,008,440		1,373,980			4,975,912	5,029,543		1,652		245	1,897		61	1,958
1951															
Inland Fleet															
Gasoline	74,648		59,718	2,841	1,149	169,659	68,616	.000227	39	.000006	p/	39	.000007	1	40
Diesel Fuel	244,100		195,280	2,841	1,149	544,790	224,377	.000213	118	.000005	1	119	.000007	5	124
Residual Fuel Oil	466,228		372,982	2,841	1,149	1,059,642	428,556	.001090	1,155	.000164	70	1,225	.000006	9	1,234
Coal	107,364		85,892	2,841	1,149	244,016	98,689						.000006	2	2
Total Inland (1951)	892,340	80	713,872			2,028,107	820,238		1,312		71	1,383		17	1,400

* Footnotes for Table 24 follow on p. 38.

S-E-C-R-E-T

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 24

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product and by Type of Fleet
1946 and 1951
(Continued)

Type of Consuming Equipment	(1) Total Horsepower a/	(2) Percent of Fleet Serviceable b/	(3) Serviceable Horsepower c/	(4) Average Number of Hours Under Way d/	(5) Average Number of Hours at Anchor e/	(6) Horsepower-Hours Under Way f/ (Thousands)	(7) Horsepower-Hours at Anchor g/ (Thousands)	(8) Petroleum Consumption per Horsepower-Hour Under Way h/ (Metric Tons)	(9) Petroleum Consumption Under Way i/ (Thousand Metric Tons)	(10) Petroleum Consumption per Horsepower-Hour at Anchor j/ (Metric Tons)	(11) Petroleum Consumption at Anchor k/ (Thousand Metric Tons)	(12) Total Petroleum Fuel Consumption l/ (Thousand Metric Tons)	(13) Lubricating Oil Consumption per Horsepower-Hour m/ (Metric Tons)	(14) Lubricating Oil Consumption n/ (Thousand Metric Tons)	(15) Total Petroleum Consumption o/ (Thousand Metric Tons)
Ocean Fleet															
Diesel Fuel	495,500	g/	495,500	2,661	3,123	1,318,526	1,547,447	.000200	264	.000040	62	326	.000007	20	346
Residual Fuel Oil	411,500	g/	411,500	2,661	3,123	1,095,002	1,285,115	.000571	625	.000120	154	779	.000006	14	793
Coal	711,250	g/	711,250	2,661	3,123	1,892,636	2,221,233		0	0	0	0	.000005	25	25
Total Ocean (1951)	1,618,250		1,618,250			4,306,164	5,053,795		889		216	1,105		59	1,164
Total (1951)	2,510,590		2,332,122			6,334,271	5,374,033		2,201		287	2,488		76	2,564

a. In 1941 the self-propelled Soviet inland water fleet consisted of about 4,060 units with a total of about 744,000 horsepower, approximately 183 horsepower per vessel. During World War II, about 1,000 self-propelled craft were destroyed or damaged. Assuming the average horsepower per vessel in 1941 was applicable to the war losses, the aggregate horsepower lost was 183,000, leaving 3,060 vessels with a total of 561,000 horsepower in operating condition in 1945. By 1946, some 20 percent of the war-damaged craft had been repaired, providing an additional 200 vessels, a total of 36,600 horsepower.

The Fourth Five Year Plan (1946-50) provided for the construction of an unknown number of inland water vessels with an aggregate horsepower of 300,000. At the end of 1950, the fleet is estimated to have comprised a total horsepower of 897,000.

Judging by the rate of progress between 1946 and 1950, the self-propelled fleet was increasing at the rate of about 54,500 horsepower annually. If the same rate was maintained during 1951, the total horsepower of the fleet at the end of that year would have been 952,100 (897,600 plus 54,500).

In 1946, approximately 87 percent of the tugs, which constitute about 85 percent of the all self-propelled vessels, were steam powered, and the remaining 13 percent were diesel powered or gasoline powered. Information on the ratios of fuel oil to coal-burning units and diesel to gasoline-powered tugs is not available. Gasoline-driven tugs are generally small, however, with individual horsepower ratings ranging from 60 to 120, indicating that the total horsepower of such vessels in 1946 was probably considerably smaller than the horsepower of the larger diesel-powered tugs. It is estimated that diesel-driven tugs comprised about 10 percent of the total fleet in 1946, whereas gasoline-driven tugs comprised about 3 percent.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 24

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product and by Type of Fleet
1946 and 1951
(Continued)

Little is known of the distribution of steam tugs in 1946. At that time, however, about 25 percent of the fleet reportedly burned hard fuel -- coal and wood. Using these data in conjunction with those above gives the following distribution of the tug fleet in 1946, according to type of petroleum fuel consumed:

Type of Petroleum Fuel Consumed	Distribution	Horsepower
Diesel Fuel	10	59,760
Gasoline	3	17,928
Residual Fuel Oil	62	370,512
Total	75	448,200

Of the tugs built in the 1946-50 period, comprising about 73 percent of all new vessel construction during the period, 52 percent were diesel powered, 32 percent were steam powered, and 16 percent were gasoline powered. Assuming that the same ratio was equally applicable to new vessels other than tugs, the distribution of the petroleum-fueled, self-propelled fleet in 1950 was as follows:

Type of Fuel	Total Horsepower (1946)	Horsepower of New Construction (1946-50)	Total Horsepower (1950)
Diesel Fuel	59,760	156,000	215,760
Gasoline	17,928	48,000	65,928
Residual Fuel Oil	370,512	81,000	451,512
Total	448,200	285,000	733,200

It can reasonably be assumed that the 54,500 horsepower added to the fleet during 1951 was distributed on the same basis as new construction during the 1946-50 period. Therefore the total horsepower of the self-propelled, petroleum-fueled fleet available at the end of 1951, distributed according to type of fuel consumed, was as follows:

Type of Fuel	Horsepower
Diesel Fuel	244,100
Gasoline	74,648
Residual Fuel Oil	466,228
Total	784,976

The aggregate horsepower of the ocean fleet is considerably more difficult to ascertain than is the inland fleet, chiefly because maritime inventories are generally obtainable only in terms of gross tonnage. When correlated with known factors of speed and engine type, however, gross tonnage provides a fairly reliable basis for estimating average horsepower. Shown in Table 24 is an inventory of the ocean fleet in 1951, arranged according to various categories of gross tonnage and the average horsepower applicable to each category. Applying the horsepower factors to the number of vessels in each gross tonnage category indicates that the total horsepower of the ocean fleet in 1951 was 1,618,250. This total is distributed between the diesel-oil-burning and residual-fuel-oil-burning vessels as follows:

Type of Fuel	Horsepower
Diesel	495,500
Residual Fuel Oil	411,500
Total	907,000

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 24

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product and by Type of Fleet
1946 and 1951
(Continued)

b. The total horsepower of each fleet is available only in potential form, as not all vessels are in operating condition simultaneously during the year. Despite attempts to confine extensive repairs to the winter season when navigation is not feasible, a large percentage of the waterway fleet is unfit for service at the beginning of the sailing period because of inadequate repair facilities at winter harbors. In addition, a certain portion of each fleet is always out of commission for some period during the navigating season. Consequently, the total horsepower potential must be reduced to conform to the average horsepower constantly serviceable during 1951.

As approximately 40 percent of the inland waterway fleet available in 1951 was constructed prior to 1917, it is estimated that the serviceability of the self-propelled fleet was only about 80 percent in 1951, despite the addition of some 350,000 horsepower since 1946. Accordingly, the serviceable inventory of the petroleum-fueled fleet in 1951 was as follows:

Type of Fuel	Serviceable Horsepower
Diesel Fuel	195,280
Gasoline	59,718
Residual Fuel Oil	372,983
Total	627,981

The part of the ocean fleet unserviceable during a year cannot be ascertained directly, but rather detailed information is available concerning the disposition of annual operating time, which includes the percent of unproductive layover time for repairs. Therefore, the reduction necessary to obtain the serviceable horsepower of the ocean fleet in 1951 is, in effect, accounted for in the calculation of operating time, which follows in footnote d.

c. Obtained by multiplying figure in column (1) by figure in column (2).

d. The period available for navigation on waterways of the USSR varies considerably from one part of the country to another. The country has been divided into four large regions, in each of which the navigation conditions are more or less uniform. The horsepower of the self-propelled fleet, however, is not distributed equally among these regions. To establish an average period of navigation for the entire country that will be adequately representative, the length of the season in each such region must be weighted according to the corresponding distribution of the fleet in each region. Accordingly, the average period of navigation for the USSR is estimated to be 190 days, arrived at by use of the following tabulation:

Region	Days of Navigating Season	Percentage Distribution of Horsepower of Self-Propelled Fleet	Average Navigating Season Weighted by Distribution of the Fleet
Northern European USSR	167	19.0	31.7
Central European USSR	197	46.4	91.4
Southern European USSR	258	13.6	35.0
Eastern USSR (Siberia)	152	21.0	31.9
Total		100.0	190.0

From the above tabulation, it is evident that the total number of hours available during the navigating season is 4,560 (190 times 24). The use of available operating time varies between waterways, however, being conditioned by the extent to which they are equipped with lighted navigation aids that permit night sailing. In 1941 about 65 percent of the navigable waterways in the USSR were lighted, but under the postwar expansion program the portion of lighted waterways has been increased, probably to about 75 percent. On the remaining rivers, navigation is generally permissible only during daylight hours, approximately 12 hours per day. On that basis the average number of hours during which navigation is possible annually is 3,990 (142.5 days times 24 hours, the period during which operation is possible on a full day basis, plus 47.5 days times 12 hours for areas where operation is possible only half the day).

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 24

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product and by Type of Fleet
1946 and 1951
(Continued)

Tugs spend an average of 75 percent of the possible navigating time under way and the remainder at anchor, while self-propelled barges are under way about 50 percent of the time. As tugs represent about 85 percent of the inland fleet, average operating times must be obtained by weighting according to the distribution of the fleet, as shown in the following tabulation:

Under Way	Percentage Distribution of Possible Navigating Time	Percentage Distribution of Fleet Horsepower	Percentage Weighting of Possible Navigating Time
Tugs	75	85	63.7
Self-Propelled Barges	50	15	7.5
Average Percent of Navigating Time Fleet Underway			71.2
At Anchor			
Tugs	25	85	21.3
Self-Propelled Barges	50	15	7.5
Average Percent of Navigating Time Fleet at Anchor			28.8

Applying the above factors to the total number of hours during which navigation is possible annually indicates that the amount of time the average waterway vessel is under way and at anchor each navigating season is 2,841 hours and 1,149 hours, respectively.

The annual period of navigation for the ocean fleet also varies from one part of the country to another. As in the case of inland waterways, a mean of the average navigating periods in the various geographic regions will not afford an average navigating season applicable to the entire ocean fleet, for the total horsepower is not evenly distributed among the various regions. Consequently, the average periods of navigation in the regions must be weighted by the corresponding distribution of the fleet horsepower in each area. The average navigating season of the ocean fleet, as shown in the following tabulation, is estimated to be 241 days.

Region	Days of Average Navigating Season	Percentage Distribution of Fleet Horsepower	Average Navigating Season Weighted by Distribution of Fleet Horsepower
Baltic Sea	302	21.1	63.7
Black Sea	347	11.2	38.8
Far East (Pacific)	187	54.7	102.3
Caspian Sea	280	13.0	36.4
Total		100.0	241.2

The average time available to each vessel during the navigating season is, therefore, 5,784 hours.

The dry cargo fleet is under way an average of 43.1 percent of the time available during the navigating period. Information concerning the disposition of the annual operating time of the wet cargo fleet is not available, but it is known that tankers spend, on the average, 42 percent less time in port for unproductive layovers than do dry cargo vessels. Assuming the same ratio applies to productive time in port and to time under way, the tanker fleet spends about 67 percent of the average navigating period at sea.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 24

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product and by Type of Fleet
1946 and 1951
(Continued)

As in the case of the waterway fleet, the factors for time under way and at anchor for the ocean fleet must be weighted according to the corresponding distribution of each fleet. The following calculation indicates that the total fleet spends an average of 46 percent of the navigating season under way and 54 percent at anchor:

Under Way	Percentage Distribution of Possible Navigating Time	Percentage Distribution of Fleet Horsepower	Percentage Weighting of Possible Navigating Time
Dry Cargo Vessels	43.1	88	37.9
Tankers	67.0	12	8.1
Average Percent of Navigating Time Fleet Under Way			46.0
At Anchor			
Dry Cargo Vessels	56.9	88	50.0
Tankers	33.0	12	4.0
Average Percent of Navigating Time Fleet at Anchor			54.0

Applying these factors to the average time available during the navigation season shows that, on the average, each vessel is under way and at anchor 2,661 hours and 3,123 hours, respectively.

e. See d. above.

f. Obtained by multiplying figure in column (3) by figure in column (4).

g. Obtained by multiplying figure in column (3) by figure in column (5).

h. One of the characteristics of diesel engines is the small variance in the fuel consumption of engines of different size. Consumption rates vary within the rather narrow limits of 0.37 pounds to 0.50 pounds per horsepower-hour (lbs per hp-hr) at full load. (While the Soviet vessels are under way, it is assumed that the engines are operated at full load.) For purposes of this estimate, a factor somewhat higher than the mean of this range or 0.47 lbs per hp-hr is used because consumption is somewhat higher for low-horsepower engines such as those used on inland waterways. To facilitate subsequent calculations, this factor is converted to its equivalent in metric tons -- 0.000213 (0.47 ÷ 2,204 lbs).

The consumption rate for diesel engines of over 1,000 horsepower averages about 0.43 lbs per hp-hr. To obtain a consumption factor adequately applicable to the total fleet, the average rates of consumption for engines with horsepower ratings above and below 1,000 must be weighted by the corresponding distribution of the fleet in these categories. Accordingly, the average rate of diesel oil consumption is estimated to be about 0.44 lbs or 0.0002 metric tons per hp-hr, arrived at by the following calculation:

Vessel Category	Consumption Factor (lbs per hp-hr)	Percentage Distribution of Horsepower of Diesel-Powered Fleet	Consumption Factor Weighted by Distribution of Horsepower of Diesel-Powered Fleet (lbs per hp-hr)
Over 1,000 hp	.43	83	.357
Under 1,000 hp	.47	17	.080
Average Consumption Rate of Diesel Oil for All Sizes of Engines			.437

A small but growing group of inland-waterway vessels is propelled by gasoline-burning engines. Consumption of gasoline by such units is slightly higher than the rate of diesel fuel consumption and averages about .5 lbs per hp-hr at full load. Converted to metric tons, 0.5 lbs equals 0.000227. Available information indicates that there are no gasoline-driven vessels in the ocean fleet.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 24

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Product and by Type of Fleet
1946 and 1951
(Continued)

Consumption of fuel oil for steam engines varies rather widely according to engine type, and rates of consumption are, on the average, considerably higher than either diesel oil or gasoline consumption rates. The theoretical rate of fuel consumption is, however, considerably below the actual rate of consumption by Soviet inland-water vessels because of the many old vessels in operation and the poor regulation of combustion. Tests conducted with steam-powered craft in the USSR indicate that fuel oil consumption averages about 2.4 lbs per hp-hr under normal operating conditions. Converted to metric tons, 2.4 lbs equals 0.00109.

The rate of fuel oil consumption for engines of over 1,000 horsepower of 1.1 lb per hp-hr is considerably less than that for smaller engines because of higher engine efficiency and better combustion regulation. To determine an average rate for the entire fleet, these factors must be weighted according to the distribution of the fuel-oil-consuming horsepower of the fleet above and below 1,000. This calculation, shown in the following tabulation, indicates that the average factor of fuel oil consumption for the fleet is 1.26 lbs, or 0.000571 metric tons, per hp-hr.

Vessel Category	Consumption Factor	Distribution of Fleet Horsepower Using Residual Fuel Oil	Weighted Consumption Factor
Over 1,000 hp	1.1	88	.97
Under 1,000 hp	2.4	12	.29
Average Consumption Rate of Fuel Oil for All Sizes of Engines			1.26

i. Obtained by multiplying figure in column (6) by figure in column (8).

j. The amount of fuel consumed by vessels at anchor (discharging, loading, waiting for a tow) varies considerably with the type of engine. For internal combustion engines burning diesel fuel and gasoline, the fuel consumption is very small because the main engines can be completely turned off and the auxiliaries used for lighting and heating. Tests conducted by Soviet engineers indicate that the fuel consumption of internal combustion engines of waterway vessels at anchor averages only 0.000005 tons and 0.000006 tons per hp-hr -- diesel-fuel and gasoline engines, respectively.

The amount of fuel consumed by steam-powered vessels at anchor is somewhat higher, however, mainly because the boiler is generally kept fired to some extent, even when the vessel is temporarily idle. Experiments with waterway vessels of the USSR indicate that the fuel oil consumption of steam-powered vessels at anchor averages about .000164 metric tons per hp-hr.

The rate of fuel consumption for vessels of the ocean fleet at anchor is somewhat higher than the rate for waterway craft, chiefly because large vessels are required to operate additional machinery while in port. According to the US Maritime Commission, fuel consumption factors for large ocean-going vessels at anchor averages about 20 percent of the fuel consumption rate while under way. Adjusting this ratio to account for the lower rate of consumption for smaller vessels of the ocean fleet at anchor, diesel fuel and residual fuel oil consumption factors of .00004 and .00012, respectively, are obtained.

k. Obtained by multiplying figure in column (7) by figure in column (10).

l. Obtained by adding figure in column (9) to figure in column (11).

m. Lubricating oil consumption of internal combustion and steam engines averages about 0.000007 tons and 0.000006 tons per hp-hr, respectively. Presumably this rate applies to engines in vessels both under way and at anchor.

n. Obtained by multiplying the sum of the figure in column (6) and the figure in column (7) by the figure in column (13).

o. Obtained by adding the figure in column (12) and the figure in column (14).

p. Less than 500 tons.

q. Included in anchorage time.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 25

Estimated Consumption of Diesel Fuel by the Soviet Inland Fleet
1951-55

Year a/	(1) Diesel Horsepower b/	(2) Annual Fuel Consumption per Horsepower c/ (Metric Tons)	(3) Total Fuel Consumption d/ (Thousand Metric Tons)	(4) Lubricant Consumption e/ (Percent of Fuel)	(5) Total Lubricant Consumption f/ (Thousand Metric Tons)	(6) Diesel Fuel and Lubes g/ (Thousand Metric Tons)
1951	244,100	.488	119	4.25	5	124
1952	264,680	.488	129	4.25	5	134
1953	307,058	.488	150	4.25	6	156
1954	351,976	.488	172	4.25	7	179
1955	399,771	.488	195	4.25	8	203

a. Mid-year inventory.
b. Diesel horsepower figures of the Soviet inland water fleet for 1951 are from source 24/. Horsepower additions to the fleet for 1952-55 are from source 25/. The 1952 mid-year inventory was obtained by reducing the 1951 horsepower by 2.5 percent (retirement rate from source 26/), adding the horsepower of Soviet-produced diesel vessels for the river fleet, adding the 1951 inventory, and dividing by 2. The same method was used for obtaining subsequent mid-year inventories.
c. The annual diesel fuel consumption per horsepower was derived from Table 24 by dividing the total diesel fuel consumption by the total horsepower of the diesel-fueled vessels in the inland fleet in 1951.
d. Total fuel (diesel) consumption is the product of the figures in column (1) and column (2).
e. The lubricant consumption factor was obtained by dividing the total lubricant consumption by diesel-fueled vessels (Table 24) by the total horsepower of the diesel-fueled vessels in the inland fleet in 1951.
f. Total lubricant consumption is the product of the figures in column (3) and column (4).
g. Sum of the figures in column (3) and column (5).

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 26

Estimated Consumption of Diesel Fuel by the Soviet Ocean Fleet
1951-55

Year a/	(1) Diesel Horsepower b/	(2) Annual Fuel Consumption per Horsepower c/ (Metric Tons)	(3) Total Fuel Consumption d/ (Thousand Metric Tons)	(4) Lubricant Consumption e/ (Percent of Fuel)	(5) Total Lubricant Consumption f/ (Thousand Metric Tons)	(6) Total Diesel Fuel and Lubricants g/ (Thousand Metric Tons)
1951	495,500	.658	326	6.13	20	346
1952	526,395	.658	346	6.13	21	367
1953	600,061	.658	395	6.13	24	419
1954	699,076	.658	460	6.13	28	488
1955	806,515	.658	531	6.13	33	564

a. Mid-year inventory.
b. Diesel horsepower figures of the Soviet ocean fleet for 1951 are from source 27/. Horsepower additions to the fleet for 1952-55 are from source 28/. The 1952 mid-year inventory was obtained by reducing the 1951 horsepower by 2.5 percent (retirement rate from source 29/), adding the horsepower of ships imported and contracted for with Western shipyards, adding the horsepower of Soviet-produced diesel vessels for the ocean and fishing fleets, adding the 1951 inventory, and dividing by 2. This same method was used for obtaining subsequent mid-year inventories.
c. The annual diesel fuel consumption per horsepower was derived from Table 24 by dividing the total diesel fuel consumption by the total horsepower of the diesel-fueled vessels in the ocean fleet in 1951.
d. Total fuel (diesel) consumption is the product of the figures in column (1) and column (2).
e. The lubricant consumption factor was obtained by dividing the total lubricant consumption by diesel-fueled vessels (Table 24) by the total horsepower of the diesel-fueled vessels in the ocean fleet in 1951.
f. Total lubricant consumption is the product of the figures in column (3) and column (4).
g. Sum of the figures in column (3) and column (5).

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 27

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Fleet and by Type of Product 1951-55

Thousand Metric Tons

Type of Product	1951	1952	1953	1954	1955
Inland Fleet a/*					
Gasoline b/	39	44	50	54	58
Diesel Fuel c/	119	129	150	172	195
Residual Fuel Oil d/	1,225	1,377	1,582	1,698	1,808
Lubricants					
Gasoline-Fueled Vessels e/	1	1	1	1	2
Diesel-Fueled Vessels f/	5	5	6	7	8
Residual Fuel Oil-Fueled Vessels g/	9	10	11	12	13
Coal-Fueled Vessels h/	2	2	3	3	3
Total Lubes i/	17	18	21	23	26
Total Petroleum Products (Inland Fleet) j/	1,400	1,568	1,803	1,947	2,087
Ocean Fleet k/					
Diesel Fuel l/	326	346	395	460	531
Residual Fuel Oil m/	779	870	941	1,012	1,019
Lubricants					
Diesel-Fueled Vessels n/	20	21	24	28	33
Residual Fuel Oil-Fueled Vessels o/	14	16	17	18	18
Coal-Fueled Vessels p/	25	28	32	35	37
Total Lubricants q/	59	65	73	81	88
Total Petroleum Products (Ocean Fleet) r/	1,164	1,281	1,409	1,553	1,638
Total Petroleum (Both Fleets) s/	2,564	2,849	3,212	3,500	3,725

* Footnotes for Table 27 follow on p. 47.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 27

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Fleet and by Type of Product 1951-55 (Continued)

a. In source 30/ the performance of the Soviet inland water fleet is given as follows:

Year	Billion Ton-Kilometers	Percentage Increase Over Previous Year
1951	51.0	
1952	57.1	12
1953	65.5	15
1954	71.0	8
1955	76.0	7

Petroleum consumption has been determined for 1951 (Table 24). Assuming that the performance of the petroleum-fueled portion of the fleet will bear the same relationship to the performance of the non-petroleum-fueled portion for the years 1952-55, petroleum consumption of the inland fleet for these years can also be determined. The following calculations derive themselves from this basic hypothesis.

b. Gasoline consumption for 1951 was calculated in Table 24. Consumption for 1952-55 based on percentage increases in performance (see a, above).

c. Diesel fuel consumption taken from Table 26.

d. Total petroleum fuel consumption of the inland fleet was obtained by applying the percentage increases in annual ton-kilometer performance to the 1951 petroleum fuel consumption (see Table 25). Residual fuel oil consumption was obtained by deducting the gasoline and diesel fuel quantities from the total obtained from this calculation and adjusting it to compensate for the lower heat content, by weight, of residual fuel oil.

e. The relationship between gasoline consumption and lubricants consumed by gasoline-fueled vessels was obtained from Table 25.

f. Taken from Table 26.

g. The relationship between residual fuel oil consumption and lubricants consumed by residual fuel oil-fueled vessels of the inland fleet was obtained from Table 25.

h. Lubricant consumption of coal-fired vessels of the inland fleet was calculated for 1951 in Table 25. The 1951 consumption figure was increased by the annual percentage increases in performance (see a, above).

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 27

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Fleet and by Type of Product 1951-55 (Continued)

i. The sum of lubricants consumed by the inland fleet.
j. The sum of gasoline, diesel fuel, residual fuel oil, and total lubricants consumed by the inland fleet.
k. In source 31/ the performance of the Soviet ocean fleet is given as follows:

Year	Billion Ton-Kilometers	Percentage Increase over Previous Year
1951	41.0	
1952	44.9	10
1953	49.2	10
1954	54.1	10
1955	56.8	5

These calculations are based on the hypothesis stated in a, above.
l. Diesel fuel consumption taken from Table 27.
m. The total petroleum fuel consumption of the ocean fleet was obtained by applying the percentage increases in annual ton-kilometer performance to the 1951 petroleum fuel consumption. Residual fuel oil consumption was obtained by deducting the diesel fuel quantities from the total obtained from this calculation and adjusting it to compensate for the lower heat content, by weight, of the residual fuel oil.
n. Taken from Table 27.
o. The relationship between residual fuel oil consumption and lubricants consumed by residual fuel oil-fueled vessels of the ocean fleet was obtained from Table 25.
p. Lubricant consumption of coal-fired vessels of the ocean fleet was calculated for 1951 in Table 25. The 1951 consumption figure was increased by the annual percentage increases in performance (see k, above).
q. The sum of residual fuel oil consumed by the ocean fleet and lubricants consumed by residual fuel-oiled vessels and coal-fueled vessels of the ocean fleet.
r. The sum of diesel fuel, residual fuel oil, and total lubricants consumed by the ocean fleet.
s. The sum of total petroleum products consumed by the inland fleet and the ocean fleet.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 28

Estimated Consumption of Petroleum Products by Water Transport in the USSR, by Type of Fleet and by Type of Product a/ 1945-55

Thousand Metric Tons

Type of Product	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Inland Fleet											
Gasoline	2	8	14	21	27	32	39	44	50	54	58
Diesel Fuel	8	26	45	63	82	100	119	129	150	172	195
Residual Fuel Oil	790	860	935	1,005	1,080	1,150	1,225	1,377	1,582	1,698	1,808
Lubricants	7	8	10	12	13	15	17	18	21	23	26
Total (Inland Fleet)	807	902	1,004	1,101	1,202	1,297	1,400	1,568	1,803	1,947	2,087
Ocean Fleet											
Diesel Fuel	289	295	301	307	314	320	326	346	395	460	531
Residual Fuel Oil	694	708	723	736	751	765	779	870	941	1,012	1,019
Lubricants	52	53	54	55	56	58	59	65	73	81	88
Total (Ocean Fleet)	1,035	1,056	1,078	1,098	1,121	1,143	1,164	1,281	1,409	1,553	1,638
Total (Both Fleets)	1,842	1,958	2,082	2,199	2,323	2,440	2,564	2,849	3,212	3,500	3,725

a. 1946 and 1951 figures are taken from Table 24. Figures for 1945 and 1947-50 are straight-line projections of the 1946 and 1951 data.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Estimates of petroleum products consumption by agriculture in the USSR are in three parts: (1) petroleum consumed by tractors; (2) petroleum consumed by combines; and (3) petroleum consumed by all other agricultural machinery, excluding trucks. The methods used in estimating consumption of petroleum products by tractors are described in Table 29 and those for combines in Table 30. Estimates of petroleum consumption of all other agricultural machinery are included in Table 31, which summarizes petroleum consumption for the 1945-55 period for all agriculture.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 29

Estimated Consumption of Petroleum Products by Agricultural Tractors in the USSR
1945-55

Thousand Metric Tons

Type of Tractor	Thousands of Soft-Plowing Units a/*	Fuel Consumption per Unit b/ (Kilograms)	Primary Fuel Consumption c/	Lubricant Consumption d/ (Percent of Fuel Consumed)	Quantity of Lubricants Consumed e/	Gasoline Consumption f/ (Percent of Fuel Consumed)	Quantity of Gasoline Consumed g/	Non-Field Work h/ (Percent of Petroleum Consumed in Field Work)	Quantity of Fuels and Lubes Consumed in Non-Field Work i/	Total Consumption of Fuels and Lubes in Both Field and Non-Field Work j/	Storage and Hauling Loss k/ (Percent of Total Consumption)	Total Petroleum Products Consumed by MTS l/	Total Petroleum Consumption, including State Farms m/
1945													
Total 1945 n/	110,000	19.2	2,112	7	148	2.0	42	7	161	2,463	123	2,586	3,154
1946													
Total 1946 n/	140,000	18.0	2,520	7	176	2.0	50	7	192	2,938	147	3,085	3,762
1947													
Kerosine													
SKhTZ	97,200	19.5	1,895	7	133	1.5	28						
Universal	14,400	17.3	249	7	17	1.5	4						
NATI	30,600	17.9	548	7	38	3.0	16						
Total Kerosine	142,200		2,692		188		48	7.8	228	3,156	158	3,314	4,041
Ligroin	23,400	18.2	426	7	30	1.5	6	2.8	13	475	24	499	609
Diesel	3,600	12.3	44	5	2	3.0	1	13.2	6	53	3	56	68
Total 1947	169,200		3,162		220		55		247	3,684	185	3,869	4,718
1948													
Kerosine													
SKhTZ	102,540	19	1,948	7	136	1.5	29						
Universal	18,340	17	312	7	22	1.5	5						
NATI	59,400	17.2	1,022	7	72	3.0	31						
Total Kerosine	180,280		3,282		230		65	7.8	279	3,856	193	4,049	4,938

* Footnotes for Table 29 follow on p. 57.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 29

Estimated Consumption of Petroleum Products by Agricultural Tractors in the USSR
1945-55
(Continued)

Thousand Metric Tons

Type of Tractor	Thousands of Soft-Plowing Units a/	Fuel Consumption per Unit b/ (Kilograms)	Primary Fuel Consumption c/	Lubricant Consumption d/ (Percent of Fuel Consumed)	Quantity of Lubricants Consumed e/	Gasoline Consumption f/ (Percent of Fuel Consumed)	Quantity of Gasoline Consumed g/	Non-Field Work h/ (Percent of Petroleum Consumed in Field Work)	Quantity of Fuels and Lubes Consumed in Non-Field Work i/	Total Consumption of Fuels and Lubes in Both Field and Non-Field Work j/	Storage and Hauling Loss k/ (Percent of Total Consumption)	Total Petroleum Products Consumed by MTS l/	Total Petroleum Consumption, including State Farms m/
1948 (Continued)													
Ligroin	24,100	17.5	422	7	30	1.5	6	2.8	13	471	24	495	604
Diesel	14,800	11.5	170	5	9	3.0	5	13.2	24	208	10	213	266
Total 1948	219,180		3,374		269		76		316	4,535	227	4,762	5,808
1949													
Kerosine													
SKhTZ	102,000	18	1,836	7	129	1.5	28						
Universal	19,000	16	304	7	21	1.5	5						
NATI	83,000	16.5	1,370	7	96	3.0	41						
Total Kerosine	204,000		3,510		246		74	7.8	299	4,129	206	4,335	5,237
Ligroin	21,400	16.7	357	7	25	1.5	5	2.8	11	397	20	417	509
Diesel	42,900	11.0	471	5	24	3.0	14	13.2	67	576	29	605	738
Total 1949	268,300		4,338		295		93		377	5,103	255	5,358	6,534
1950													
Kerosine													
SKhTZ	102,700	17	1,746	7	122	1.5	26						
Universal	19,300	15	290	7	20	1.5	4						
NATI	94,700	15.9	1,506	7	105	3	45						
Total Kerosine	216,700		3,542		247		75	7.8	301	4,165	208	4,373	5,333

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 29

Estimated Consumption of Petroleum Products by Agricultural Tractors in the USSR
1945-55
(Continued)

Thousand Metric Tons

Type of Tractor	Thousands of Soft-Flowing Units a/	Fuel Consumption per Unit b/ (Kilograms)	Primary Fuel Consumption c/	Lubricant Consumption d/ (Percent of Fuel Consumed)	Quantity of Lubricants Consumed e/	Gasoline Consumption f/ (Percent of Fuel Consumed)	Quantity of Gasoline Consumed f/	Non-Field Work h/ (Percent of Petroleum Consumed in Field Work)	Quantity of Fuels and Lubes Consumed in Non-Field Work i/	Total Consumption of Fuels and Lubes in Both Field and Non-Field Work j/	Storage and Hauling Loss k/ (Percent of Total Consumption)	Total Petroleum Products Consumed by MTS l/	Total Petroleum Consumption, including State Farms m/
1950 (Continued)													
Ligroin	20,900	16	334	7	23	1.5	5	2.8	10	372	19	391	477
Diesel	83,500	10.5	877	5	44	3	26	13.2	125	1,072	54	1,126	1,373
Total 1950	321,100		4,753		314		106		436	5,609	281	5,390	7,183
1951													
Kerosine													
SKhTZ	102,500	16.4	1,681	7	118	1.5	25						
Universal	22,200	14	311	7	22	1.5	5						
NATI	115,700	15.2	1,759	7	123	3	53						
Total Kerosine	240,400		3,751		263		83	7.8	320	4,417	221	4,638	5,656
Ligroin	21,800	15.2	331	7	23	1.5	5	2.8	10	369	18	387	472
Diesel	119,000	9.98	1,188	5	59	3	36	13.2	169	1,452	72	1,524	1,859
Total 1951	381,200		5,270		345		124		499	6,238	311	6,549	7,987
1952													
Kerosine													
SKhTZ	75,900	16.4	1,245	7	87	1.5	19						
Universal	23,700	14	332	7	23	1.5	5						
NATI	125,400	15.2	1,906	7	133	3	57						
Total Kerosine	225,000		3,483		243		81	7.8	297	4,104	205	4,309	5,255
Ligroin	23,700	15.2	360	7	25	1.5	5	2.8	11	401	20	421	513
Diesel	181,000	10	1,810	5	91	3	54	13.2	258	2,213	111	2,324	2,834
Total 1952	429,700		5,653		359		140		566	6,718	336	7,054	8,602

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 29

Estimated Consumption of Petroleum Products by Agricultural Tractors in the USSR
1945-55
(Continued)

Thousand Metric Tons

Type of Tractor	Thousands of Soft-Plowing Units a/	Fuel Consumption per Unit b/ (Kilograms)	Primary Fuel Consumption c/	Lubricant consumption d/ (Percent of Fuel Consumed)	Quantity of Lubricants Consumed e/	Gasoline Consumption f/ (Percent of Fuel Consumed)	Quantity of Gasoline Consumed g/	Non-Field Work h/ (Percent of Petroleum Consumed in Field Work)	Quantity of Fuels and Lubes Consumed in Non-Field Work i/	Total Consumption of Fuels and Lubes in Both Field and Non-Field Work j/	Storage and Hauling Loss k/ (Percent of Total Consumption)	Total Petroleum Products Consumed by MTS l/	Total Petroleum Consumption, including State Farms m/
1953													
Kerosine													
SKhTZ	65,700	16.4	1,077	7	75	1.5	16						
Universal	25,300	14.0	354	7	25	1.5	5						
NATI	136,400	15.2	2,073	7	145	3	62						
Total Kerosine	227,400		3,504		245		83	7.8	299	4,131	207	4,338	5,290
Ligroin	27,200	15.2	413	7	29	1.5	6	2.8	13	461	23	484	590
Diesel	257,600	10	2,576	5	129	3	77	13.2	367	3,149	157	3,306	4,032
Total 1953	512,220		6,493		403		166		679	7,741	387	8,128	9,912
1954													
Kerosine													
SKhTZ	51,000	16.4	836	7	59	1.5	12						
Universal	27,000	14	378	7	26	1.5	6						
NATI	144,000	15	2,160	7	151	3	65						
Total Kerosine	222,000		3,374		236		83	7.8	288	3,981	199	4,180	5,098
Ligroin	12,000	15.2	182	7	13	1.5	3	2.8	6	204	10	214	261
Diesel	365,000	10	3,650	5	183	3	110	13.2	520	4,463	223	4,686	5,714
Total 1954	599,000		7,206		432		196		814	8,648	432	9,080	11,073

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 29

Estimated Consumption of Petroleum Products by Agricultural Tractors in the USSR
1945-55
(Continued)

Thousand Metric Tons

Type of Tractor	Thousands of Soft-Plowing Units a/	Fuel Consumption per Unit b/ (Kilograms)	Primary Fuel Consumption c/	Lubricant Consumption d/ (Percent of Fuel Consumed)	Quantity of Lubricants Consumed e/	Gasoline Consumption f/ (Percent of Fuel Consumed)	Quantity of Gasoline Consumed g/	Non-Field Work h/ (Percent of Petroleum Consumed in Field Work)	Quantity of Fuels and Lubes Consumed in Non-Field Work i/	Total Consumption of Fuels and Lubes in Both Field and Non-Field Work j/	Storage and Hauling Loss k/ (Percent of Total Consumption)	Total Petroleum Products Consumed by MTS l/	Total Petroleum Consumption, Including State Farms m/
1955													
Kerosine													
SKhTZ	43,000	16.4	705	7	49	1.5	11						
Universal	29,000	14	406	7	28	1.5	6						
KaTI	145,000	15	2,175	7	152	3	65						
Total Kerosine	217,000		3,286		229		82	7.8	281	3,378	194	4,072	4,966
Diesel	503,000	10.2	5,131	5	257	3	154	13.2	732	6,274	314	6,588	8,034
Total 1955	720,000		8,417		486		236		1,013	10,152	508	10,660	13,000

a. 32/
b. 33/
c. Obtained by multiplying soft-plowing units by fuel consumption per unit (in kilograms).
d. 34/
e. Obtained by multiplying primary fuel consumption by lubricant consumption (percent of fuel consumed).
f. 35/
g. Obtained by multiplying primary fuel consumption by gasoline consumption (percent of fuel consumed).
h. 36/
i. Obtained by multiplying non-field work (percent of petroleum consumed in field work) by the appropriate sums of primary fuel consumption, quantity of lubricants consumed, and quantity of gasoline consumed.
j. Obtained by adding primary fuel consumption, lubricants consumed, gasoline consumed, and fuels and lubes consumed in non-field work.
k. Obtained by taking 5 percent of total consumption of fuels and lubes in both field and non-field work. 37/
l. Obtained by adding total consumption of fuels and lubes in both field and non-field work and storage and hauling loss.
m. It is concluded that the tractor part of the MTS consumes 82 percent of the petroleum consumed by the total agricultural tractor park. 38/ This percentage has been applied to obtain the totals.
n. Insufficient data preclude further subdivision.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 30

Estimated Consumption of Petroleum Products by Agricultural Combines in the USSR
1945-55

Thousand Metric Tons

Year	Type of Combine	Number of Combines a/*	Total Hectares of Grain Crops b/ (Thousands)	Percent Harvested by Combines c/ (Approximate)	Hectares of Grain Harvested by Combines d/ (Thousands)	Total Hectares of Sunflowers e/ (Thousands)	Percent Harvested by Combines f/ (Approximate)	Hectares of Sunflowers Harvested by Combines g/ (Thousands)	Total Hectares Harvested by Combines h/ (Thousands)	Gasoline Consumption per Hectare i/ (Kilograms)	Total Gasoline Consumption j/	Lubricant Consumption k/ (5 Percent Gasoline)	Storage and Handling Losses l/ (5 Percent Total Consumption)	Total Consumption of Petroleum Products m/
1945	Kommunar	60,150			7,686			488	8,174	4.5	37	2	2	41
	S-1	60,150			8,455			537	8,992	4.5	40	2	2	44
	S-4	0			0			0	0	10.0	0	0	0	0
	S-6	300			42			3	45	4.5	n/	n/	n/	n/
	Total	120,600	89,908	18	16,183	2,507	41	1,028	17,211		77	4	4	85
1946	Kommunar	59,550			8,215			681	8,896	4.5	40	2	2	44
	S-1	59,550			9,035			749	9,784	4.5	44	2	2	48
	S-4	0			0			0	0	10.0	0	0	0	0
	S-6	1,600			242			20	262	4.5	1	n/	n/	1
	Total	120,700	92,061	19	17,492	3,020	48	1,450	18,942		85	4	4	93
1947	Kommunar	58,350			16,570			737	17,357	4.5	78	4	4	86
	S-1	58,350			18,227			865	19,092	4.5	86	4	4	94
	S-4	280			79			4	83	10.0	1	n/	n/	1
	S-6	4,100			1,280			60	1,340	4.5	6	n/	n/	6
	Total	121,080	96,606	37	36,156	3,177	54	1,716	37,872		171	8	8	187
1948	Kommunar	56,600			17,149			811	17,960	4.5	81	4	4	89
	S-1	56,600			18,363			891	19,754	4.5	89	4	5	98
	S-4	4,000			1,212			57	1,269	10.0	13	1	1	15
	S-6	14,800			4,932			233	5,165	4.5	23	1	1	25
	Total	132,000	99,852	42	42,156	3,320	60	1,992	44,148		206	10	11	227

* Footnotes for Table 30 follow on p. 58.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 30

Estimated Consumption of Petroleum Products by Agricultural Combines in the USSR
1945-55
(Continued)

Thousand Metric Tons

Year	Type of Combine	Number of Combines a/	Total Hectares of Grain Crops b/ (Thousands)	Percent Harvested by Combines c/ (Approximate)	Hectares of Grain Harvested by Combines d/ (Thousands)	Total Hectares of Sunflowers e/ (Thousands)	Percent Harvested by Combines f/ (Approximate)	Hectares of Sunflowers Harvested by Combines g/ (Thousands)	Total Hectares Harvested by Combines h/ (Thousands)	Gasoline Consumption per Hectare i/ (Kilograms)	Total Gasoline Consumption j/	Lubricant Consumption k/ (5 Percent Gasoline)	Storage and Handling Losses l/ (5 Percent Total Consumption)	Total Consumption of Petroleum Products m/
1949	Kommunar	54,350			16,200			769	16,971	4.5	76	4	4	84
	S-1	54,350			17,822			845	18,667	4.5	84	4	4	92
	S-4	16,000			4,770			226	4,996	10.0	50	3	3	56
	S-6	31,600			10,362			492	10,854	4.5	49	2	3	54
	Total	156,300	102,408	48	49,156	3,380	69	2,332	51,488		259	13	14	286
1950	Kommunar	51,500			13,583			647	14,230	4.5	64	3	3	70
	S-1	51,500			14,940			712	15,652	4.5	70	4	4	78
	S-4	38,800			10,233			488	10,721	10.0	107	5	6	118
	S-6	54,200			15,724			749	16,473	4.5	74	4	4	82
	Total	196,000	102,800	53	54,480	3,556	73	2,596	57,076		315	16	17	348
1951	Kommunar	48,550			12,768			605	13,373	4.5	60	3	3	66
	S-1	48,550			14,046			665	14,771	4.5	66	3	3	72
	S-4	67,300			17,700			839	18,539	10.0	185	9	10	204
	S-6	77,400			22,392			1,061	23,493	4.5	106	5	6	117
	Total	241,800	106,200	63	66,906	3,913	81	3,170	70,076		417	20	22	459
1952	Kommunar	45,150			11,732			560	12,342	4.5	56	3	3	62
	S-1	45,150			12,960			615	13,575	4.5	61	3	3	67
	S-4	87,300			22,782			1,082	23,864	10.0	239	12	13	264
	S-6	96,100			27,586			1,310	28,896	4.5	130	7	7	144
	Total	273,700	107,300	70	75,110	4,100	87	3,567	78,677		486	25	26	537

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

S-E-C-R-E-T

Table 30

Estimated Consumption of Petroleum Products by Agricultural Combines in the USSR
1945-55
-(Continued)

Thousand Metric Tons

Year	Type of Combine	Number of Combines a/	Total Hectares of Grain Crops b/ (Thousands)	Percent Harvested by Combines c/ (Approximate)	Hectares of Grain Harvested by Combines d/ (Thousands)	Total Hectares of Sunflowers e/ (Thousands)	Percent Harvested by Combines f/ (Approximate)	Hectares of Sunflowers Harvested by Combines g/ (Thousands)	Total Hectares Harvested by Combines h/ (Thousands)	Gasoline Consumption per Hectare i/ (Kilograms)	Total Gasoline Consumption j/	Lubricant Consumption k/ (5 Percent Gasoline)	Storage and Handling Losses l/ (5 Percent Total Consumption)	Total Consumption of Petroleum Products m/
1953	Kommunar	42,500			10,808			520	11,328	4.5	51	3	3	57
	S-1	42,500			11,888			572	12,460	4.5	56	3	3	62
	S-4	107,800			27,413			1,318	28,731	10.0	287	14	15	316
	S-6	114,300			31,973			1,538	33,511	4.5	151	8	8	167
	Total	307,100	106,600	77	82,082	4,200	94	3,948	86,030		545	28	29	602
1954	Kommunar	41,500			9,365			461	9,826	4.5	44	2	2	48
	S-1	41,500			10,301			507	10,808	4.5	49	2	3	54
	S-4	119,500			26,966			1,329	28,295	10.0	283	14	15	312
	S-6	167,500			41,577			2,049	43,626	4.5	196	10	10	216
	Total	370,000	103,900	81	88,209	4,390	99	4,346	92,555		572	28	30	630
1955	Kommunar	41,000			9,073			407	9,480	4.5	43	2	2	47
	S-1	41,000			9,980			447	10,427	4.5	47	2	2	51
	S-4	123,000			28,325			1,271	29,596	10.0	296	15	16	327
	S-6	223,000			54,232			2,435	56,717	4.5	255	13	13	281
	Total	433,000	119,600	85	101,660	4,560	100	4,560	106,220		641	32	33	706

a. 39/
b. 40/
c. 41/
d. In calculating the number of hectares harvested by the various types of combines, use has been made of Soviet data concerning the productivity of the different models. According to source 42/ the productivity of the S-6 is given as 2.0 hectares per hour. In source 43/ the productivity of the Kommunar and the S-4 (a self-propelled combine) is given as 1.8 hectares per hour. The productivity of the S-1 model is not known, but it is assumed to be the same as that of the S-6 because both combines are powered by the same motor. The number of hectares harvested by the various types of combines has been calculated by using these productivity weightings. The assumption has been made that each type of combine is in operation for an equal period of time during the year.

S-E-C-R-E-T

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 30

Estimated Consumption of Petroleum Products by Agricultural Combines in the USSR
1945-55
(Continued)

e. 44/
f. 45/
g. In the absence of information indicating which types of combines were used to harvest sunflowers, the acreage harvested by the different models was calculated in the same manner as the grain acreage in d. above.
h. Obtained by adding hectares of grain harvested by combines and hectares of sunflowers harvested by combines.
i. Gasoline consumption per hectare harvested for the Kommunar, S-1 and S-6 models, is from source 46/. The gasoline consumption per hectare harvested by the S-4 (self-propelled) is from source 47/.
j. Obtained by multiplying total hectares harvested by combines by gasoline consumption per hectare.
k. 48/
l. This is a minimum allowance for losses in storing and handling petroleum products in MTS's. 49/
m. Summation of total gasoline consumption, lubricant consumption, and storage and handling losses.
n. Less than 500 tons.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 31

Estimated Consumption of Petroleum Products by Agricultural Machines in the USSR, by Type of Product
1945-55

Thousand Metric Tons

	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Agricultural Tractors a/											
Gasoline	57	70	75	104	129	146	172	195	232	277	336
Ligroin			561	556	470	439	436	474	544	239	0
Kerosine	2,895 b/	3,452 b/	3,716	4,531	4,845	4,889	5,178	4,809	4,837	4,657	4,536
Diesel Fuel			65	247	683	1,272	1,722	2,623	3,734	5,291	7,438
Lubricants	202	240	301	370	407	437	479	501	565	609	690
Subtotal	3,154	3,762	4,718	5,808	6,534	7,183	7,987	8,602	9,912	11,073	13,000
Combines c/											
Gasoline	81	89	179	216	272	331	437	511	573	600	673
Lubricants	4	4	8	11	14	17	22	26	29	30	33
Subtotal	85	93	187	227	286	348	459	537	602	630	706
Other Agricultural Machinery d/											
Gasoline	34	38	76	92	117	142	188	219	246	258	289
Lubricants	2	2	4	5	6	7	9	11	12	12	14
Subtotal	121	133	267	324	409	497	656	767	860	900	1,009
Total											
Gasoline	172	197	330	412	518	619	797	925	1,051	1,135	1,298
Ligroin			561	556	470	439	436	474	544	239	0
Kerosine	2,895 b/	3,452 b/	3,716	4,531	4,845	4,889	5,178	4,809	4,837	4,657	4,536
Diesel Fuel			65	247	683	1,272	1,722	2,623	3,734	5,291	7,438
Lubricants	208	246	313	386	427	461	510	538	606	651	737
Total All Products	3,275	3,895	4,985	6,132	6,943	7,680	8,643	9,369	10,772	11,973	14,009

a. Data from Table 29.
b. Aggregate figure including ligroin, kerosine, and diesel fuel.
c. Data from Table 30.
d. Combine petroleum consumption is 70 percent of total petroleum consumption by agricultural machinery, excluding tractors and trucks. 50/

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2
Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 32

Estimated Number of Kerosine Lamps in Households in the USSR
1945-55

Year	Rural Dwelling Units a/ (Thousands)	Urban Dwelling Units b/ (Thousands)	Percent of Rural Dwellings Electrified c/	Percent of Urban Dwellings Electrified d/	Number of Rural Dwelling Units Without Electricity e/ (Thousands)	Number of Urban Dwelling Units Without Electricity f/ (Thousands)	Number of Lamps in Nonelectrified Rural Dwelling Units (1 per Unit) g/ (Thousands)	Number of Lamps in Nonelectrified Urban Dwelling Units (2 per Unit) h/ (Thousands)	Total Number of Kerosine Lamps i/ (Thousands)
1945	25,000	9,000	10	65	22,500	3,150	22,500	6,300	28,800
1946	25,000	9,150	10	66	22,500	3,110	22,500	6,220	28,720
1947	25,000	9,300	10	67	22,500	3,070	22,500	6,140	28,640
1948	25,000	9,400	10	68	22,500	3,010	22,500	6,020	28,520
1949	25,000	9,550	10	69	22,500	2,960	22,500	5,920	28,420
1950	25,000	9,740	10	70	22,500	2,920	22,500	5,840	28,340
1951	25,400	10,633	10	71	22,900	3,080	22,900	6,160	29,060
1952	25,770	11,533	10	72	23,200	3,230	23,200	6,460	29,660
1953	26,140	12,467	10	73	23,500	3,370	23,500	6,740	30,240
1954	26,510	13,533	10	74	23,900	3,520	23,900	7,040	30,940
1955	26,880	14,600	10	75	24,200	3,650	24,200	7,300	31,500

a. 51/
b. 52/
c. More than 2.3 million kolkhoz homes had been electrified at the beginning of 1950. 53/ In addition, more than 2.3 million farmer's houses have electric light. 54/ It is inferred that about 10 percent of the rural dwellings in 1950 were electrified. Inasmuch as progress in rural electrification between 1945 and 1950 is believed to have been insignificant, this percentage has been applied to the 1945-50 period. From 1951-55, it is believed that the increase in the number of rural dwellings will just about equal the rate of increase in rural electrification. For the 1951-55 period, the same percentage is considered applicable.
d. 55/
e. Obtained by taking 90 percent of rural dwelling units.
f. Obtained by applying the percent of urban dwellings electrified to the number of urban dwelling units.
g. It is assumed that each nonelectrified rural dwelling unit has one kerosine-burning lamp. 56/ Undoubtedly, there is a great number of such dwelling units that have no kerosine-burning lamps, while others may have two or more, depending on the income of the occupant. It has also been reported that even the electrified rural dwellings generally contain one or more kerosine lamps for use in case of power failure and to reduce the periodic charges for electricity. In view of all these conditions, it is believed that the average of one kerosine-burning lamp per nonelectrified rural dwelling is a reasonable estimate.
h. As is the case in electrified rural dwellings, it is also common for electrified urban dwellings to use kerosine lamps to supplement electricity and in case of power failures. Very likely there are urban dwelling units that have less than two lamps, but the estimate of two lamps per nonelectrified urban dwelling unit appears to be the most reasonable conclusion.
i. Obtained by adding the number of lamps in nonelectrified rural dwellings and the number of lamps in nonelectrified urban dwellings. The production of kerosine lamps in 1930 is stated to have been 9.5 million annually: 7.5 million by the Moscow "Metal-lamp" Plant, and 2 million by the Leningrad's Concession Association Plant "Yan Serkovskiy." 57/ In view of these production figures, despite their age, the number of lamps in the entire USSR does not appear to be high.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 33

Estimated Consumption of Lamp Kerosine in Households in the USSR
1945-55

Year	Number of Kerosine Lamps a/ (Thousands)	Number of Lamp Hours per Year b/ (Millions)	Kerosine Consumption per Lamp Hour c/ (Grams)	Total Lamp Kerosine Consumption d/ (Thousand Metric Tons)
1945	28,800	28,800	50	1,440
1946	28,720	28,720	50	1,436
1947	28,640	28,640	50	1,432
1948	28,520	28,520	50	1,426
1949	28,420	28,420	50	1,421
1950	28,340	38,340	50	1,417
1951	29,060	29,060	50	1,453
1952	29,660	29,660	50	1,483
1953	30,240	30,240	50	1,512
1954	30,940	30,940	50	1,547
1955	31,500	31,500	50	1,575

a. Data taken from Table 32.
b. It has been estimated that, on the average, each lamp in the USSR burns about 1,000 hours a year. During the winter half of the year each lamp probably burns 4 or 5 hours per day, but during the summer half only one to 2 hours per day. 58/ In order to be on the conservative side, it is estimated that each lamp burns something less than 3 hours per day which, multiplied by 365, gives about 1,000 hours per year.
c. Consumption rates of Soviet kerosine lamps vary from 43 grams per hour for a smoky, impractical model to 272 grams per hour for a wickless, pressure-fed one. Several models consume from 60 to 90 grams per hour. 59/ Again, in order to be on the conservative side, since the final estimate of kerosine consumption is based on so many factors, a consumption rate of 50 grams per hour appears reasonable. Such a rate compares favorably with US-produced kerosine lamps.
d. Obtained by multiplying number of lamp hours per year by kerosine consumption per lamp-hour.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 34

Estimated Consumption of Stove Kerosine in Households in the USSR
1945-55

Year	Number of New Kerosine Stoves in Use a/ (Thousands)	Number of Stove-Hours per Year per Stove b/	Kerosine Consumption per Stove Hour c/ (Grams)	Consumption of Kerosine by New Stoves d/ (Thousand Metric Tons)	Total Kerosine Consumption by Stoves e/ (Thousand Metric Tons)
1945	N.A.	N.A.	N.A.	N.A.	400
1946	N.A.	N.A.	N.A.	N.A.	450
1947	N.A.	N.A.	N.A.	N.A.	500
1948	N.A.	N.A.	N.A.	N.A.	600
1949	N.A.	N.A.	N.A.	N.A.	750
1950	500	700	438	150	900
1951	1,650	700	438	495	1,245
1952	3,100	700	438	930	1,680
1953	4,900	700	438	1,470	2,220
1954	7,880	700	438	2,364	3,114
1955	11,300	700	438	3,390	4,140

a. The number of new kerosine stoves in use has been calculated from a reported statement: "To bring the production of kerosine stoves and kerosine burners in 1954 up to 2,966,000 units and in 1955 up to 3,843,000 units; that is, to increase production by nearly 3 times as compared with 1950." 60/ The production schedule represented by these figures is estimated as follows:

Year	Number of Units Produced
1950	1,000,000 (inferred)
1951	1,250,000 (interpolated)
1952	1,600,000 (interpolated)
1953	2,000,000 (interpolated)
1954	2,966,000 (given)
1955	3,843,000 (given)

To obtain the number of new stoves in use, a mid-year inventory has been calculated from that production schedule.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 34

Estimated Consumption of Stove Kerosine in Households in the USSR
1945-55
(Continued)

b. 61/.
c. A wick 1 inch wide burns from 27 to 30 milliliters of kerosine per hour. 62/ Since it is believed that the wicks average about 6 inches in diameter, the consumption rate per stove per hour would be 438 grams.
d. Obtained by multiplying the product of the number of new kerosine stoves in use and the number of stove-hours per year per stove by kerosine consumption per stove.
e. Before World War II, agriculture consumed 66 percent of the total Soviet production of kerosine. 63/ In 1940 the output of kerosine from the nation's refineries is estimated to have been about 6 million tons (the 1941 Plan called for over 7 million tons, which was never realized because of World War II). Of this total about 4 million tons was consumed in the agricultural sector, almost exclusively by tractors. 64/ The remaining 2 million tons must have been consumed almost entirely in Soviet households for lighting and cooking purposes: 1.4 million tons of lamp kerosine and 600,000 tons of stove kerosine. In view of the diminution of crude oil production during and immediately after the war, it is believed that 1940 conditions did not again prevail until 1948, when crude oil output was about equal to that of 1940. Inasmuch as refining practices did not change materially over this period, it is reasonable to assume that kerosine production in 1948 was also about the same as in 1940 -- about 6 million tons, 2 million of which was consumed by kerosine-burning lamps and stoves in the Soviet households. In Table 33, it is estimated that kerosine lamps consumed 1,426,000 tons, leaving about 600,000 tons for stove consumption. For the years 1945-47, stove kerosine consumption is estimated to have been somewhat less than in 1948 because of lower crude oil production, and is so indicated. The increase in stove kerosine consumption estimated for 1949 reflects the increase in crude oil production. Consumption for 1950 was obtained by adding the consumption of half the year's output of new stoves (an estimated 1 million were produced -- the estimated mid-year inventory is, therefore, 500,000) to the 1949 consumption level. In estimating 1951-55 consumption, all stoves produced before 1950 are estimated to consume 750,000 tons per year, to which is added the consumption of the post-1949 stove inventory.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Determination of the pattern of petroleum products consumption by Soviet industries is a particularly difficult task. In the last 20 years, the USSR has released practically no data relating to industrial petroleum requirements.

Inasmuch as the pattern of industrial consumption of petroleum is an integral part of the larger pattern of civil petroleum consumption, which has been designated by the IAC as a primary intelligence gap, considerable effort has been made to estimate industrial consumption. Devious approaches have been attempted, mostly without marked success. These are described in the following paragraphs in the hope that they may serve as guidance to successors and to others currently engaged in similar research.

A widely used method for arriving at estimates of Soviet production and consumption levels of various commodities and materials is the comparison of similar and related sectors of the Soviet and the US economies. Despite conceptual and institutional differences, there may be certain sectors of the economies to which this method may be applied with considerable confidence in the results. In others, however, the differences are of such magnitude, or are of such natures, that they simply are not analogous. In the research pertaining to this research aid, scrupulous attention was given to the question of whether consumption of petroleum by certain Soviet industries was analogous to that of similar industries in the US. Involved in this question are such factors as the maximum use of local fuels, accessibility to petroleum resources, and degree of mechanization. From an analysis of these factors in relation to specific industrial practices, it was concluded that particularly in the case of lubricants, the consumption pattern by certain Soviet industries would closely approximate that of comparable US industries. Given the consumption of lubricants per ton of output for a US industry, for example, this ratio applied to the output of a comparable Soviet industry should yield a reasonable lubricant consumption figure.

In theory, this method appears to be reasonably sound, despite its obvious shortcomings. In practice, however, several barriers made application impossible. The most formidable of these barriers is the lack of suitable data on lubricant consumption by intermediate industrial sectors of the US economy. Very little such data are available. There is only one known attempt to designate the quantities and value of industrial lubricating oils and greases shipped to

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

(for all practical purposes, "consumed by") intermediate industrial sectors (bituminous coal production, copper rolling and drawing, construction and mining machinery, and the like) during a particular year on a national basis. 65/ With these data it would be possible to develop quantitative relationships between lubricant consumption and output tonnages for specific industries. Assuming that US practices in vogue at the time in these industries resemble closely those in the Soviet Union, applying the factors to the estimated output of the Soviet counterparts would yield a consumption pattern. The validity of such a pattern would, of course, depend on how representative the US practices were of Soviet practices.

Before calculating US lubricant consumption/output tonnage factors, a close examination was made of the methodology used in constructing the primary products shipment appendix. In the US in 1947, 18,128,000 barrels of lubricating oils were designated for industrial use. This quantity was aggregated from sales data collected by the Census Bureau of the US Department of Commerce. After allocating all direct estimates of industrial lubricants to specific industries, there remained a residual of approximately 13,500,000 barrels. In other words, only 25 percent of the total industrial lubricants sold in 1947 could be identified by recipient. In many cases, the remaining 75 percent was allocated among the manufacturing industries on the basis of kilowatt-hours of electric energy used. In industries where most of the electric energy used was for electrolytic processes and, therefore, bore no relationship to machinery in use, allocations were based on employment figures. Unfortunately, these estimated allocations have not been verified. Perhaps it would be possible to check these criteria against the industries whose total allocations were included in the 25 percent that was identified. Such checking was considered to be beyond the scope of this research aid. Inasmuch as 75 percent of the total industrial lubricating oils could not be allocated to specific industries because of data limitations, and inasmuch as the criteria used in estimating the allocations have not been verified, calculation of consumption/output factors for the US was considered too inaccurate.

Also in the primary product shipments appendix are allocations of other petroleum products to intermediate industrial sectors of the US economy. It is believed that for these products, US practice

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

is not analogous to Soviet practice and, therefore, development of consumption/output ratios is unjustified.*

As far as it is known, there appears to be very little industrial consumption of kerosine in the USSR. Most of the civilian supply of kerosine is consumed by agricultural tractors and households. (See Appendix A.) Although households show up as a large kerosine consumer in the US, there is not such a large kerosine-burning tractor park. In 1951, 66 percent of the total petroleum consumption by the Soviet tractor park was kerosine (Table 31). In the US during the same year, kerosine consumed by tractors on farms was less than 3 percent of the total liquid fuel consumption. 66/ These data strongly suggest that the kerosine consumption pattern in the USSR is quite different from that in the US. Deriving Soviet kerosine consumption on the basis of US data would, therefore, be hardly defensible.

With regard to fuel oils, the US data are wholly unsatisfactory in estimating Soviet consumption. In the US, distillate fuel oils are widely used for home heating, which is not the case in the USSR. 67/ Residual fuel oil is used as a boiler fuel by many industries in the US, particularly those on the eastern seaboard, where it is off-loaded from tankers carrying Gulf oil or Caribbean oil. This US practice reflects a rather unique situation wherein residual fuel has displaced coal in places where coal mines are nearby. Of course, the only places in the country where this situation can prevail is where residual fuel oil can be brought in at low freight rates -- that is, the eastern seaboard. In the USSR, however, the whole planning effort in the energy field is devoted to making various parts of the country as self-sustaining as possible. The effect of this program on the fuel situation is to intensify the use of local fuels. 68/ In view of the wide differences in approach to fuel utilization between the USSR and the US, fuel oil analogues would be difficult to support. Moreover, the primary products shipments appendix does not differentiate between the various kinds of petroleum fuel oils; it

* These comments should not be taken to mean that US analogues have no application in determining the use pattern of petroleum in the USSR. They specifically refer to the application on a national scale of analogues derived from the US Labor Department's interindustry study. In some industries, US analogues may yield satisfactory or fairly reliable results. However, the determination of the degree of reliability can be made only by that component of ORR directly concerned with monitoring that particular Soviet industry.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

includes them all in one category. Even if US experience in consuming diesel fuel were considered representative of Soviet practice, no suitable US data could be obtained from this source.

In view of its limitations, the petroleum section of the US interindustry study has not been used in this paper to develop petroleum consumption/output ratios. If satisfactory factors cannot be developed for the US with the abundant data available, the problem with regard to the USSR is all the more difficult.

Inasmuch as the Soviet fuel economy is predicated on the maximum use of local fuels, the pattern of residual fuel oil consumption in the US is of little use in working out a similar pattern for the USSR. If the regional pattern of fuel oil consumption for even one large Soviet industry were available, however, it would be possible to deduce a ratio between total boiler fuel and residual fuel oil consumed in each region. Assuming this ratio to be representative of all other industries in that region, which is a fairly sound assumption, then applying it to the regional requirements of boiler fuel would give a residual fuel oil consumption pattern, by economic regions. In addition, if requirements of boiler fuel were known, by economic regions and for intermediate industrial sectors, then residual fuel oil consumption by sectors could also be deduced.

As part of CIA ORR Project 10.122, Structural (Interindustry) Analysis of the Soviet Economy, some of the branches in the Materials, Industrial, and Services Divisions of ORR estimated inputs of petroleum products to the parts of the Soviet economy with which they are concerned. From these contributions the petroleum products inputs into Soviet industries have been extracted, including the basis for the estimates. In some cases, it has been possible to supplement the original contributions with more recent and complete information. It is to be noted, however, that the consumption pattern resulting from these contributions is fragmentary. Based on these contributions, with certain amendments, the petroleum consumption pattern of Soviet industries in 1951 is shown in Table 35.* Analysis of the petroleum consumption of each industry identified in this table is presented in sections 1 through 12, below.

1. Petroleum Production and Refining Industry.

In the industrial sector of the Soviet economy, the largest consumer of petroleum is the petroleum industry itself. It should be noted, however, that not all the petroleum consisted of petroleum

* Table 35 follows on p. 69.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Table 35

Estimated Consumption of Petroleum Products by Industry in the USSR, by Type of Product 1951

Thousand Metric Tons

Consuming Industry	Gasoline	Diesel Fuel	Residuals	Lubricants	Total
Petroleum	0	0	1,200	0	1,200
Electric Power	0	282	3,200	24	3,506
Construction	950	950	300	76	2,276
Iron and Steel	0	0	1,342	222	1,564
Chemical	0	0	151	0	151
Shipbuilding	0	0	119	0	119
Automotive Equipment Manufacturing	0	0	0	56	56
Coal and Manufactured Gas	2	11	0	23	36
Aircraft	0	0	0	32	32
Railroad Equipment	0	0	0	50	50
Electrical Equipment	0	0	0	2	2
Ball and Roller Bearings	0	0	0	1	1
Total	952	1,243	6,312	486	8,993

products, nor was all of it employed in useful work. Part of it was crude oil used as a substitute for fuel oil, while part was lost in various stages of production, refining, storage, and transportation operations.

Soviet theoretical calculations and field observations indicate that 3.5 percent of the crude oil produced is lost, principally through evaporation, between the measuring or gaging tanks in the oil fields and the petroleum refineries. 69/ It is known that, in addition to these losses, sizable quantities of crude and residual fuel oil have been burned under boilers in the producing fields and elsewhere. In 1936, for example, Soviet reports show that 1.6 million tons of crude oil, nearly 6 percent of the crude produced in that year, were burned under boilers as a substitute for fuel oil. 70/ Since that time, this wasteful practice has been the

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

target of much criticism and self-criticism in the Soviet press. It is assumed that by 1951 the burning of crude oil under boilers in the oil fields had been reduced to 1 percent by weight of the crude produced. 71/ Thus it appears that 4.5 percent of the crude produced in 1951 was not refined. It must, however, be considered as having been consumed by the petroleum industry in producing operations.

In addition to losses of petroleum in the producing phase of the industry, there are also losses in the refining phase which also must be considered as consumption by the petroleum industry. In petroleum refining, certain losses may be anticipated in the process of converting crude oil to petroleum products. These losses result from the formation of gases during the refining process and from the formation of carbon deposits and other waste on the refinery apparatus. From a detailed analysis of Soviet refining operations, it has been estimated that process losses amount to about 8 percent of the crude oil charge, which may be considered more or less normal for the types of equipment and processes in vogue in the USSR. In addition, abundant evidence suggests that there are abnormal or unnecessary losses of crude oil and petroleum products in Soviet refineries. Such losses result from careless storage operations, excessive down time of refining units, broken lines, inefficient heat exchangers, and other causes. These losses, which have also been attacked in the Soviet press, have been conservatively estimated at 1 percent by weight of the crude oil refinery runs. The total process loss in Soviet refineries for 1951 amounts to 9 percent of crude oil refinery charge. 72/

In the process of converting crude oil to petroleum products, substantial quantities of heat are required. In petroleum refineries, this heat is generally derived from burning part of the refinery output, principally residual fuel oil. It is estimated that in 1951 the quantity of residual fuel oil so used was equivalent to about 3 percent of the crude oil charge, or 1.2 million tons. 73/

2. Electric Power Industry.

Of the identified industrial consumers of petroleum products in the USSR, the largest consumer is the electric power industry. In the national production of electric power, however, petroleum fuels play only a minor role -- of the total electric power generated in 1951, only 8.2 percent is believed to have been derived from

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

petroleum products. 74/ Locally, petroleum fuels assume greater significance in electric power production, particularly in Economic Regions* Ib, IIb, IV, V, and Xb. 75/

Residual fuel oil, or mazut, predominates over all the other petroleum products used in the generation of electric power. The following calculation was used to estimate the residual fuel oil consumption of this industry for 1951 76/:

a. Total electric power production, 1947 -- 55.0 billion kilowatt-hours (kwh).

b. Estimated MES** (Ministry of Electric Power Stations) production, 70 percent of the total -- 38.5 billion kwh.

c. 7.5 percent of MES production derived from mazut -- 2.88 billion kwh.

d. Average consumption of standard fuel (7,000 Cal***/kg) by MES in 1947 -- 0.574 kg/kwh.

e. Average calorific value of mazut -- 9,370 Cal/kg.

f. Ratio of mazut to standard fuel (9,370/7,000) -- 1.34.

g. Average consumption of mazut by MES -- 0.428 kg/kwh.

h. Mazut consumption by MES (item c times item g) -- 1,240,000 tons.

i. Non-MES consumption of mazut assumed to be at the same rate as MES -- 530,000 tons.

j. Total mazut consumption, 1947 -- 1,770,000 tons.

* The term region in this research aid refers to the economic regions defined and numbered on CIA Map 12048.1, 9-51 (First Revision, 7-52), USSR: Economic Regions.

** Now divided into the Ministry of Electric Power Stations, the Ministry of the Electrical Industry, and the Ministry of the Radio-Technical Industry.

*** Great calories, or kilocalories.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

k. Although 1951 power production was about 87 percent greater than that of 1947, the average MES consumption of standard fuel decreased 7.5 percent. It is assumed for the purpose of estimating 1951 mazut consumption that it is being consumed at the same rate. Therefore, Item j is increased by 80 percent for the 1951 estimate of 3.2 million tons.

Only one of the petroleum distillates, diesel fuel, is used to any great extent in the generation of electric power in the USSR. Most of the diesel fuel so used is believed to be consumed in small, isolated stations beyond the MES networks. Such stations may be situated at radio stations, hospitals, remote communities, or Machine Tractor Stations, particularly in Economic Regions IIa, III, V, and Xb. 77/

It is believed that in 1949 about 550 million kwh was produced in stations using diesel-powered generators. 78/ The average consumption of diesel fuel is calculated to have been .389 kg/kwh, which results in a diesel fuel consumption of 214,000 tons. Inasmuch as the 1951 Soviet production of electric power increased 32 percent over 1949, 79/ it has been assumed that diesel fuel consumption increased proportionally. For 1951, therefore, the consumption of diesel fuel for electric power production is estimated to have been 282,000 tons.

In addition to residual fuel oil and diesel fuel, the only other petroleum products used in significant quantities in the electric power industry are lubricants. It is estimated on the basis of US experience that in 1951 14,000 tons of transformer oil and 2,000 tons of such lubricating oils as steam cylinder oils, turbine oils, and machine oil were consumed. 80/ According to Soviet sources, consumption of lubricants by diesel engines, principally diesel oil, amounts to about 3 percent of diesel fuel consumption. 81/ On this basis, consumption of diesel oil in 1951 was about 8,000 tons. The total lubricant consumption by the electric power industry was about 24,000 tons.

3. Construction Industry.

For the operation of its construction equipment park, the Soviet construction industry consumes sizable quantities of motor gasoline, diesel fuel, and lubricants. It is estimated that in 1951 the value of the construction equipment park amounted to 8,550,000,000

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

rubles. With a calculated average price per metric ton of construction equipment of 10,500 rubles, the total park comprised about 815,000 metric tons of equipment, or 900,000 short tons. 82/

In the US, fuel consumption of what is considered to be comparable equipment ranges between 3 and 4 gallons per day per short ton of equipment. Assuming this ratio approximates Soviet practice, fuel consumption of the Soviet construction equipment park is calculated to have been between 2.5 million and 3.5 million gallons per day in 1951. It is further estimated that the equipment park was operated for about 200 days during that year, for an annual fuel consumption of about 1.9 million tons. 83/ This quantity is assumed to have been about equally divided between motor gasoline and diesel fuel. 84/

Lubricant consumption by the construction equipment park has been calculated as a function of the fuel consumption. Diesel-burning vehicles consume lubricants at a rate approximating 3 percent of fuel consumption, while gasoline-burning equipment consumes lubricants at about 5 percent of the fuel consumption. 85/ Lubricant consumption of the construction equipment park was, therefore, about 76,000 tons in 1951.

In addition to petroleum fuels for operating its equipment, the Soviet construction industry consumes practically all of the asphalt produced by the petroleum industry. Asphalt output has been estimated to have been 2 percent of the total yield of residuals, about 300,000 tons in 1951. 86/ Since production of asphalt by the Commissariat of Building Materials in 1941 was planned to have been 150,000 tons, and volume of construction in 1951 was about twice that for 1941, 87/ the asphalt consumption estimate appears to be reasonable.

4. Iron and Steel Industry.

Residual fuel oil, the main petroleum product used in the Soviet iron and steel industry, is believed to be used in significant quantities only in steel rolling and drawing and in iron and steel castings. The only other petroleum products consumed in large quantities are lubricants, which are used throughout the industry.

The calculation of residual fuel oil consumption in steel rolling and drawing is based largely on Soviet data, which indicate

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

that 30 percent of the total output of open-hearth steel (25,370,000 tons in 1951) was produced in oil-fired furnaces. Since residual fuel oil has about 18,000 Btu per pound (39,600 Btu per kg) and since 4.5 million Btu are required to melt 1 ton of steel, open-hearth residual fuel oil consumption works out to have been 865,000 tons. In the soaking pits, through which passed about 28.4 million tons of steel ingots in 1951, 2 million Btu are required to heat each ton of steel prior to the rolling process. With 15 percent of the soaking pits being oil fired, the residual fuel oil consumption works out to have been 215,000 tons. The third process in which residual fuel oil is used is in the reheat furnaces, 15 percent of which are oil-fired. With the reheat considered to take place at an 80 percent yield, residual fuel oil consumption is calculated to have been 172,000 tons. The total residual fuel oil consumption in steel rolling and drawing was, therefore, about 1,252,000 tons. 88/

For iron and steel castings, about 5 million Btu are required to melt each ton of open-hearth cast steel. With an output of 2,380,000 tons of iron and steel castings in 1951 and with 30 percent of the open-hearth furnaces being oil fired, residual fuel oil consumption is calculated to have been about 90,000 tons. 89/

Estimates of lubricant consumption by the Soviet iron and steel industry are based on recent practices in the US, which give rise to the following factors 90/:

Type of Lubricant	Quantity Required per Ton of Steel Produced
Lubricating Oils	0.31 Gallons
Gear Oils and Greases	0.85 Pounds
Hydraulic and Specialty Oils	0.55 Gallons
Cutting and Quenching Oils	0.176 Gallons
Coating Oils	0.88 Gallons
Wire-Drawing Greases	0.044 Pounds
Pipe-Threading Grease	0.044 Pounds
Slushing Oils	0.055 Gallons

Although recourse to US analogy may be quite unsatisfactory in some cases, it is believed that the lubricant consumption pattern in the Soviet iron and steel industry probably cannot be greatly different from that in the US. With a total steel output of 31.2 million tons in 1951, 91/ the lubricant consumption is believed to have been about 222,000 tons.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

5. Chemical Industry.

In the Soviet chemical industry, residual fuel oil requirements have been identified for the production of three major chemical products: chemical caustic soda, soda ash, and synthetic rubber. In 1951, residual fuel oil consumption by the Soviet chemical industry totaled about 152,000 tons.

According to Soviet sources, the manufacture of 1 ton of caustic soda requires, among other things, 2,400 kg of steam. Three plants are believed to use residual fuel oil for raising steam. In 1951 these plants produced about 89,000 tons of caustic soda. Since 870 to 880 kg of standard fuel are required to produce the steam requirements for 1 ton of caustic soda, only 615 kg of residual fuel oil are required per ton of caustic soda. In 1951, therefore, residual fuel oil consumption for caustic soda production was about 55,000 tons. 92/

In the calcination of sodium bicarbonate for the production of soda ash, two Soviet plants are believed to use residual fuel oil at the rate of about 95 kg per ton of soda ash output. In 1951 these plants are estimated to have produced 370,000 tons of soda ash, consuming in the process some 35,000 tons of residual fuel oil. 93/

Soviet plans for the production of synthetic rubber called for 18 million Cal of heat per ton of rubber output. In firing the contact furnaces, part of the fuel is believed to consist of residual fuel oil. The consumption rate in 1951 is estimated to have been 0.45 tons of residual fuel oil per ton of output. With an estimated production of 137,000 tons of synthetic rubber by this process in 1951, residual fuel oil consumption is calculated to have been about 62,000 tons. 94/

6. Shipbuilding Industry.

Petroleum products consumption by the Soviet shipbuilding industry has been calculated on the basis of a ratio between total annual steel requirements and petroleum products consumption, as revealed by data on US practices. These data indicate that .222 tons of petroleum products was consumed per ton of steel used. Inasmuch as there are few mechanized operations in the shipbuilding industry, practically all this petroleum was probably residual fuel

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

oil. In 1951, steel requirements for the Soviet shipbuilding industry totaled about 536,000 tons. Residual fuel oil consumption was about 119,000 tons. In the USSR, however, there is a possibility that a higher percentage of the boiler fuel used in the shipyards is solid fuel than is the case in the US. Evidence to support this contention quantitatively is not available at this time. 95/

7. Automotive Equipment Manufacturing Industry.

Petroleum products consumed in the manufacture of automotive equipment in the USSR consist almost wholly of lubricants. During 1947 in the US, 0.125 tons of lubricants was consumed for each 2-ton unit produced. This relationship is presumed to be reasonably representative of Soviet practice in 1951 when 449,100 2-ton units are believed to have been produced. In the process, some 56,000 tons of lubricants were consumed. 96/

8. Railroad Equipment Manufacturing Industry.

Lubricants are the only types of petroleum products used in large quantities by the Soviet railroad equipment manufacturing industry. Based on US data, the 1951 consumption of lubricants by this industry is estimated to have been about 50,000 tons. 97/

9. Coal and Manufactured Gas Industry.

In estimating the volume of petroleum products consumed by the Soviet coal and manufactured gas industry, Czechoslovakia and British data have been used. These are believed to be more representative of Soviet practice than similar data for the US industry. 98/

According to the 1949 Plan in Czechoslovakia, mining requirements for petroleum products were as follows:

Petroleum Product	Tons per 1,000 Tons of Output
Motor Fuel and Industrial Gasoline	0.007
Lubricants	0.077

Inasmuch as 99 percent of the tonnage mined in Czechoslovakia in 1949 was coal, these factors are believed representative of coal mining requirements. Applying these factors to the Soviet coal

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

output of 282.4 million tons in 1951, it appears that about 2,000 tons of gasoline and 23,000 tons of lubricants were consumed in the operation. 99/

In the production of manufactured gas from coal in Great Britain in 1950, 0.039 tons of distillate fuel oil was consumed per 1,000 cubic meters of manufactured gas output. Applying this factor to the Soviet output of manufactured gas from coal of 285 million cubic meters in 1951, gives a distillate fuel oil consumption of about 11,000 tons. Altogether, this industry consumed about 36,000 tons of petroleum products in that year. 100/

10. Aircraft Manufacturing Industry.

Consumption of petroleum products, exclusively lubricants, has been estimated for the Soviet aircraft manufacturing industry in 1951 on the basis of US plant experience. US airframe manufacturers have supplied data which made possible the development of annual consumption factors for lubricants in relation to plant area. Lubricants consumption in engine-producing plants has been based on a comparison of electric energy requirements in airframe and engine production. On the basis of these factors, the consumption of lubricants by the Soviet aircraft manufacturing industry in 1951 is estimated to have been about 32,000 tons. 101/

11. Electrical Equipment Industry.

The only petroleum product known to be used in any significant quantity in the Soviet electrical equipment industry is transformer oil, which is classified as a lubricant. The volume of transformer oil consumed in 1951 by the industry was obtained by multiplying the quantity of oil required for each oil-immersed transformer by the number of such transformers produced. In that year, transformer oil consumption is calculated to have been about 2,000 tons. 102/

12. Ball and Roller Bearings Industry.

Based on US data, the 1951 consumption of lubricants by the Soviet ball and roller bearings industry is estimated to have been approximately 1,000 tons. 103/

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Because adequate data on petroleum consumption of individual Soviet industries have not been developed, it has not been possible to arrive at national consumption estimates by aggregation. For petroleum distillates, it has been possible to estimate industrial consumption from the relationship between agricultural and nonagricultural tractors. For consumption of residuals and lubricants, however, the only recourse at this time was first to estimate total supply and, after deducting estimates of other civil consumption and estimated peacetime consumption by the Soviet military forces, to assume that the remainder was consumed by Soviet industry.

In estimating the quantity and types of petroleum distillates consumed by Soviet industry, use has been made of distillate consumption estimates of agricultural tractors (see Table 29). The ratio of agricultural to nonagricultural tractors has been derived. 104/ All of the nonagricultural tractor park is assumed to be scattered among various branches of industry, with the great majority in the construction branch. Although tractors are believed to comprise the bulk of petroleum distillate consuming equipment in Soviet industry, there is a multitude of other industrial users of such petroleum products. Some of these are cement mixers, air compressors, diesel generators, and power shovels. Lack of data, however, makes impossible separate estimates of each of these consumers. To include such uses, nonagricultural tractor consumption has been increased by an arbitrary factor of 10 percent, which is believed to be conservative.

In applying the ratio of agricultural to nonagricultural tractors, the mix of tractor types in the nonagricultural tractor park for the years 1945-50 is believed to parallel closely that in the agricultural tractor park. Beginning in 1950, the number of kerosine-burning tractors allocated to the nonagricultural tractor park started decreasing rapidly, and very few have been added. Most of the post-1950 tractors added to the nonagricultural park have been dieselpowered. 105/ Accordingly, kerosine consumption by the nonagricultural park is estimated to have leveled off in 1951 at about 1 million tons. The few such units added since that year are estimated to have equalled the retirement rate of old kerosine tractors. These factors have been considered in estimating consumption of petroleum distillates shown in Table 9.

In estimating the quantity of residuals and lubricants consumed by industry in the USSR, it has been necessary first to

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

estimate the total supply (production plus imports minus exports) for each of the years in the 1945-55 period. 106/ From supply for each year was deducted estimates of residuals and lubricants, derived in Appendix B, Sections 1 through 6, as well as peacetime consumption of the Soviet military forces. 107/ The balance resulting from this computation is assumed to have been consumed by industry. (This balance also includes whatever change in stock levels there may have been, but lack of information precludes estimating both the direction and magnitude of such a change.) Consumption estimates of residuals and lubricants are given in Table 9.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

APPENDIX C

GAPS IN INTELLIGENCE

Quantitative estimates of petroleum consumption by the civil economy of the USSR can be made only by aggregating estimates of individual consuming sectors. Of the seven consuming sectors that have been analyzed in this research aid, reasonably adequate information is available for five -- motor transport, rail transport, water transport, air transport, and agriculture. For households and industry, however, there remain serious intelligence gaps, and the data problems in these two sectors differ greatly from each other.

In the households sector, it will be recalled that consumption of petroleum products, principally kerosine, was estimated by introducing a number of assumptions. Although these assumptions appear sound, they have not been sufficiently verified by primary sources. This is particularly true of the assumptions underlying estimates of lamp kerosine consumption. Moreover, estimates of stove kerosine consumption are derived primarily from plan goals and not from plan accomplishments. In an effort to gain additional information on these aspects, formal requirements have been levied on collection agencies. It is to be hoped that in the near future replies to these requirements will provide a basis for re-examining the estimates made in this research aid and reducing the estimated margin of error.

Except for distillates, petroleum consumption estimates were made not by aggregation but by first estimating total supply and then arriving at industrial consumption by deduction. This methodology leaves much to be desired. First, its margin of error depends on the accuracy with which supply can be estimated. Second, its margin of error also depends on the accuracy of consumption estimates of non-industrial sectors, including the allowance for peacetime military consumption. Third, it does not provide separate estimates of petroleum consumption by individual branches of industry.

Whereas firmer consumption estimates of the households sector are feasible within the near future, a similar statement cannot be made with respect to industry. At the outset it must be recognized that petroleum is used to some degree in all branches of industry. Consequently, the industrial consumption pattern, or use

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

pattern, is a particularly complex one. Estimates of petroleum consumption by branches of industry would have to be based on a rather detailed analysis of the prevailing technology in each branch. The most efficient approach under these conditions would appear to be that each component of CRR estimate the petroleum inputs of the sector of Soviet industry it is monitoring. Petroleum consumption estimates for all industry could then be made by aggregation. Such an approach would also yield a more detailed use pattern for the industrial sector, which would facilitate analysis of the over-all petroleum supply/demand balance under wartime conditions.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

APPENDIX D

SOURCES

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

---

1. 1945-53: Commerce, US Bureau of Mines, official data. U. Eval. RR 1.
   1954-55: Commerce, US Bureau of Mines estimate. U. Eval. RR 1.
2. Current Digest of the Soviet Press, Vol. VI, No. 12, 5 May 1954. U. Eval. RR 1.
3. CIA/RR PR-17 (I-F), Civil Consumption of Petroleum Products in the USSR, 19 Jun 1952. TS.
4. CIA, ORR S/TR estimate, May 1954. S.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

5. Avtomobil'naya i Traktornaya Promyshlennost', No. 8, 1953, p. 12. U. Eval. RR 2.

25X1A8a

6. [redacted] 16 Apr 1954. S, US OFFICIALS ONLY.
7. CIA, ORR M/P and S/TR estimate, May 1954. S.
8. Bronshteyn and Budrin, Planirovaniy i uchet avtomobil'nogo transporta, Gosplanizdat, Moscow, 1948, p. 120. U. Eval. RR 2.
9. Ibid.
10. Ibid.
11. CIA/RR PR-17, op. cit.
12. Pravda, 29 Jan 1952. U. Eval. RR 3.
13. H. Hunter, Soviet Transportation Policy, unpublished manuscript, Oct 1953. U. Eval. RR 2.
14. CIA, ORR S/TR estimates, May 1954. S.
15. CIA, ORR S/TR contribution to ORR Project 10.122, 9 Dec 1953. TS.
16. Ibid.
17. CIA/RR 27, Production of Locomotives and Rolling Stock in the USSR and the European Satellites, 31 Dec 1953. S, US OFFICIALS ONLY.

25X1A8a

18. [redacted] Daily Report, 4 Mar 1953. C.
19. CIA, ORR S/TR contribution to ORR Project 10.122, 9 Dec 1953. S.
20. OSS, R & A No. 2516, Domestic Consumption of Petroleum Products in the USSR, 1945-52, 30 Apr 1945. C. Eval. RR 3.
21. Department of Defense estimate, Jun 1954. U.
22. Ibid.
23. CIA, ORR S/TR contribution to ORR Project 10.122, 9 Dec 1953. TS.
24. Ibid.
25. CIA, ORR I/SH contribution to ORR Project 10.122, 9 Dec 1953. S.
26. CIA, ORR I/SH estimate, May 1954. S.
27. CIA, ORR S/TR contribution to ORR Project 10.122, 9 Dec 1953. TS.
28. CIA, ORR I/SH contribution to ORR Project 10.122, 9 Dec 1953. S.
29. CIA, ORR I/SH estimate, May 1954. S.
30. CIA, ORR S/TR contribution to ORR Project 13.310, Soviet Bloc Economic Capabilities and Changes in Policy Through Mid-1959, unpublished.
31. Ibid.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

32. CIA, ORR Project 32.292, The Tractor: The Industry and Its Role in the USSR, 1940-53, May 1954, unpublished. S.
33. Ibid.
34. Tekhnicheskiye normy na nefteprodukty, Moscow, 1952. U. Eval. RR 2.
35. CIA, ORR Project 32.292, op. cit.
36. Ibid.
37. Ibid.
38. Ibid.
39. CIA, ORR I/MM estimates, 19 Apr 1954. S.
40. CIA, ORR S/PM and M/AG estimates, Apr-May 1954. S.
41. Ibid.
42. Sel'skokhozyaystvenniye mashiny i zapasnye chasti k nim, Book 2, Mashgiz, Moscow, 1953. U. Eval. RR 2.
43. M.N. Portnov, Samokhodnyy kombain, 1950. U. Eval. RR 2.
44. CIA, ORR S/PM and M/AG estimates, Apr-May 1954. S.
45. Ibid.
46. Sel'khozmashina, Jul 1951. U. Eval. RR 2.
47. Portnov, op. cit.
48. Tekhnicheskiye normy na nefteprodukty, op. cit.
49. Opyt Raboty MTS, Moscow, 1948. U. Eval. RR 2.
50. CIA, ORR S/PM and M/AG estimates, May 1954. S.
51. CIA, ORR S/CST estimate, 18 Mar 1954. S.
52. CIA, ORR S/CST estimate, 5 May 1954. S. 25X1X7
53. Voprosy Ekonomiki, No. 7, 1951. U. Eval. RR 2.
54. [redacted] Kommunist, 21 Jan 1950. U. Eval. RR 2. 25X1A8a
55. CIA, ORR M/P estimate, concurred in by M/EP, 28 May 1954. S.
56. [redacted] May 1954, unpublished. C, US OFFICIALS ONLY. 25X1X7
[redacted] May 1954, unpublished. C, US OFFICIALS ONLY.
57. Bol'shaya Ensiklopediya, Vol. 17, 1930. U. Eval. RR 2.
58. [redacted] May 1954, unpublished. C, US OFFICIALS ONLY.
[redacted] May 1954, unpublished. C, US OFFICIALS ONLY.
59. Bol'shaya Ensiklopediya, Vol. 17, 1930 and Vol. 35, 1937. U. Eval. RR 2. 25X1A8a
60. [redacted]
61. CIA, ORR M/P estimate, Jun 1954. S.
62. US Federal Specifications, VV-L-791, ASTM Test No. D-187-49. U. Eval. RR 1.
63. S.P. Matskevich, "O tipakh traktorob v sel'skom kyozyajstve SSSR," Sotsialisticheskoye Sel'skoye Khozaystvo, No. 12, 1943. Eval. RR 2.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

64. CIA, ORR Project 32.292, op. cit.
65. Bureau of Labor Statistics, Division of Interindustry Economics, I-O 2911 Petroleum Refining, Table III-Outputs, 1947, revised Oct 1953. U. Eval. RR 2.
66. Petroleum Facts and Figures, Tenth Edition, American Petroleum Institute, 1952. U. Eval. RR 1.
67. CIA/RR PR-17, op. cit.
68. CIA FDD, Report U-5249, 23 Dec 1953. OFFICIAL USE ONLY.
69. Neftebazy, Moscow 1947. U. Eval. RR 2.
70. CIA/RR PR-17, op. cit.
71. Ibid.
72. Ibid.
73. Ibid.
CIA, ORR Project 25.192, Production of Natural Gas and Natural Gas Liquids in the USSR, 26 Feb 1954. S.
74. CIA, ORR M/EP contribution to ORR Project 10.122, 11 Dec 1953. S.
25X1A5a1
75. [redacted]
25X1X7
25X1A5a1
76. CIA, ORR M/EP contribution to ORR Project 10.122, op. cit.
25X1X7
77. [redacted]
25X1A5a1
78. [redacted]
25X1X7
79. CIA, ORR M/EP estimate, 15 Mar 1954.
80. CIA, ORR M/EP contribution to ORR Project 105-51, Allocation of Energy Resources in the USSR, unpublished. S.
81. Teknicheskiye normy na nefteprodukty, op. cit.
82. CIA, ORR S/CST contribution to ORR Project 10.122, 11 Dec 1953. S.
83. Ibid.
84. CIA, ORR I/TH estimate, 21 Mar 1954. S.
85. Teknicheskiye normy na nefteprodukty, op. cit.
86. CIA, ORR M/P estimate, 1 Dec 1953. S.
87. CIA, ORR S/CST contribution to ORR Project 10.122, 11 Dec 1953. S.
88. CIA, ORR M/FM contribution to ORR Project 10.122, 11 Dec 1953. S.
89. Ibid.
90. CIA, ORR M/FM contribution to ORR Project 105-51, op. cit.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

91. CIA, ORR M/FM contribution to ORR Project 10.122, 11 Dec 1953. S.
92. CIA, ORR M/CH contribution to ORR Project 10.122, 11 Dec 1953. S.
93. Ibid.
94. Ibid.
95. CIA, ORR I/SH contribution to ORR Project 10.122, 19 Nov 1953. S.
96. CIA, ORR I/TH contribution to ORR Project 10.122, 14 Dec 1953. S.
97. Ibid.
98. CIA, ORR M/SF contribution to ORR Project 10.122, 11 Dec 1953. S.
99. Ibid.
100. Ibid.
101. CIA, ORR I/AR contribution to ORR Project 10.122, 11 Dec 1953. S.
102. CIA, ORR I/EE contribution to ORR Project 10.122, 11 Dec 1953. S.
103. CIA, ORR I/TH contribution to ORR Project 10.122, 14 Dec 1953. S.
104. CIA, ORR Project 32.292, op. cit.
105. CIA, ORR D/I estimate, Jun 1954.
106. CIA, ORR M/P Project 25.192, op. cit.
CIA, ORR M/P estimates, Jun 1954. S.
107. CIA compilation of estimates submitted by Air, A-2, Army, G-2, and ONI in connection with ORR Project 110-51. TS.

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2

Approved For Release 1999/09/08 : CIA-RDP79S01046A000100080001-2